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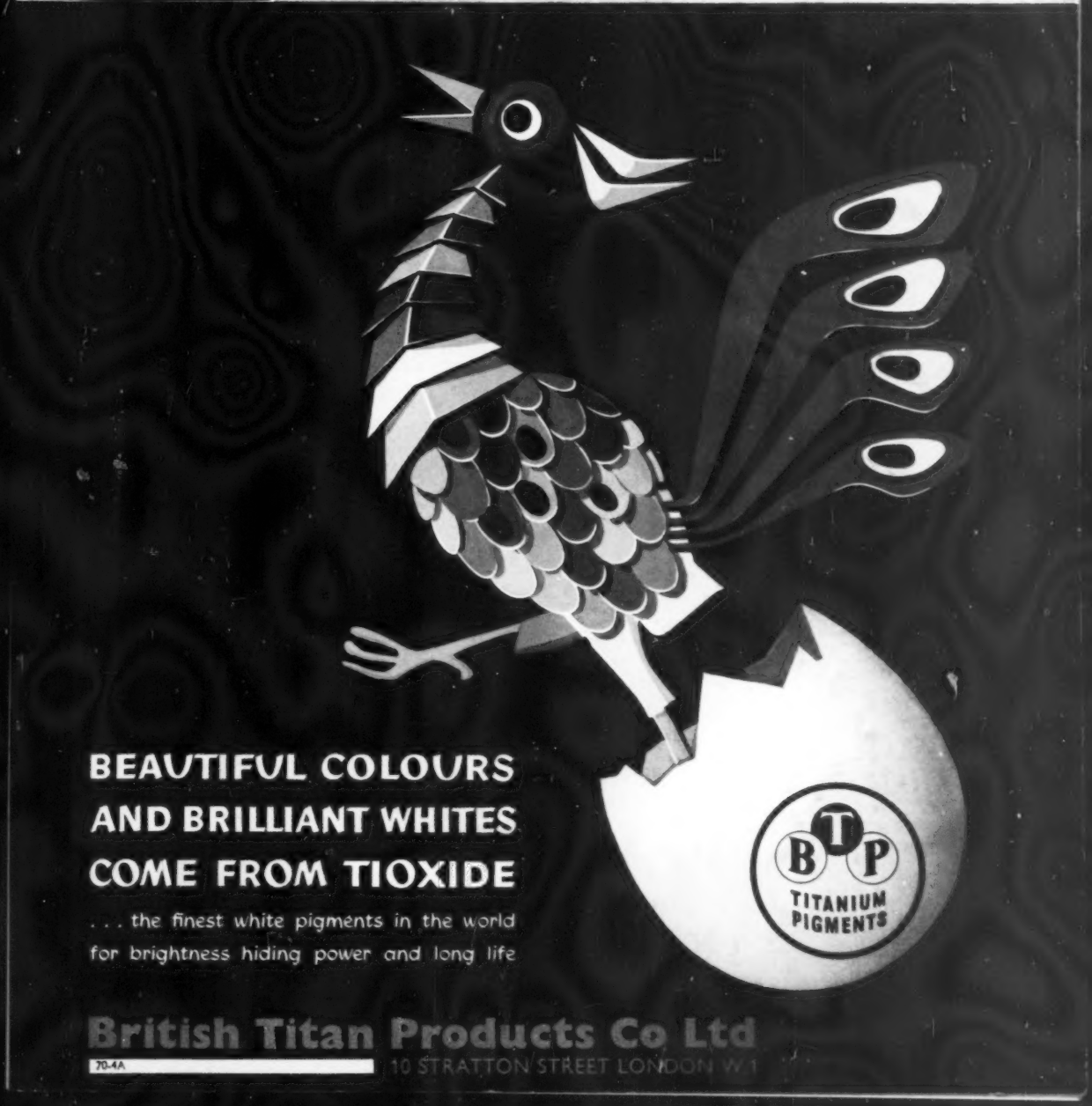
Vol. 5 No. 59 (New Series) NOVEMBER, 1959



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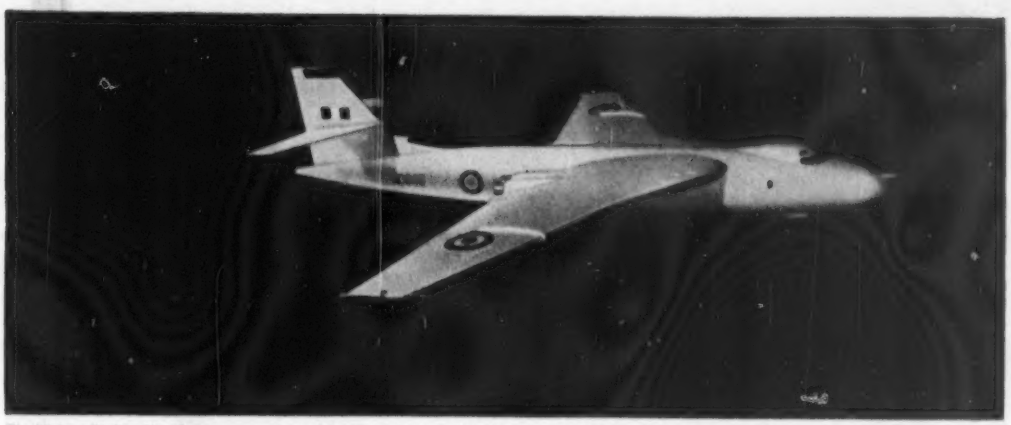

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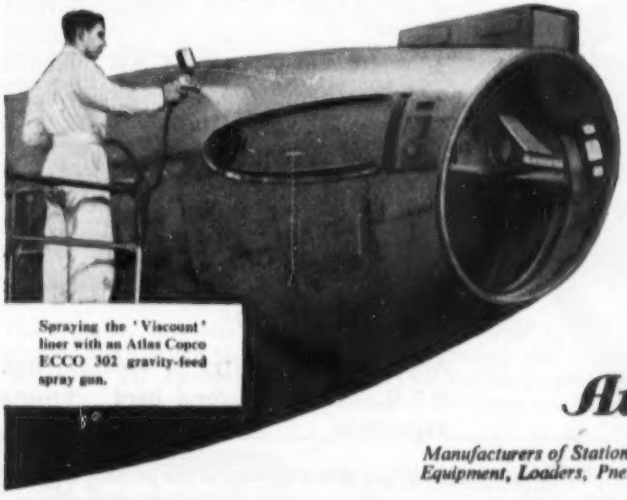

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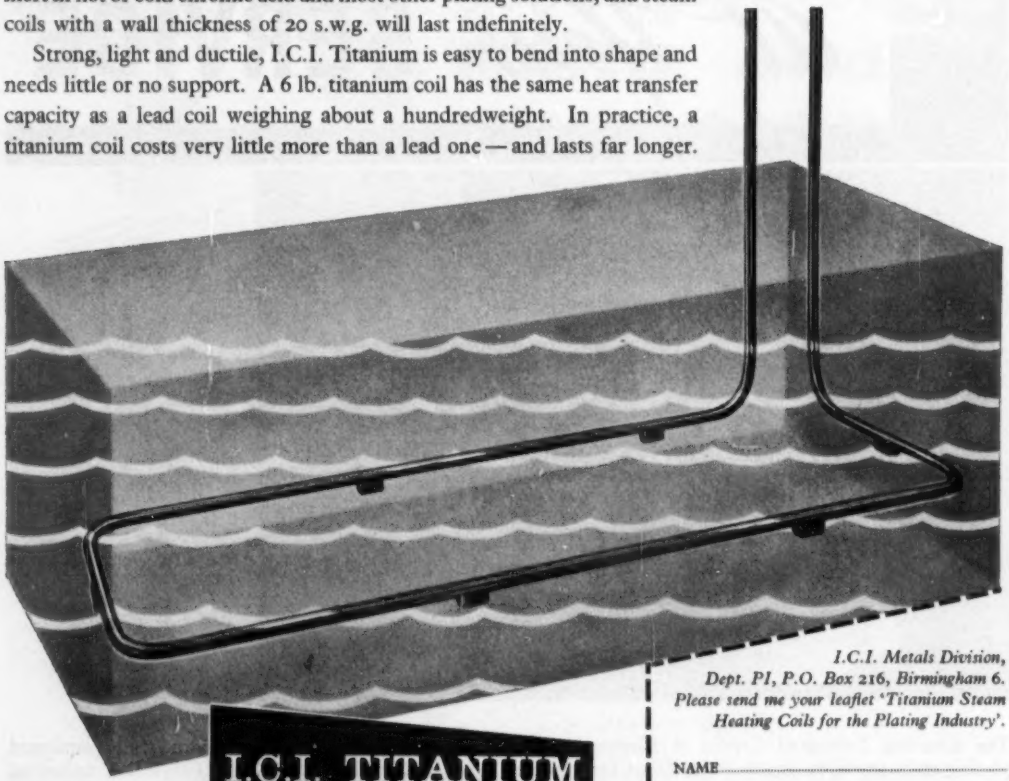

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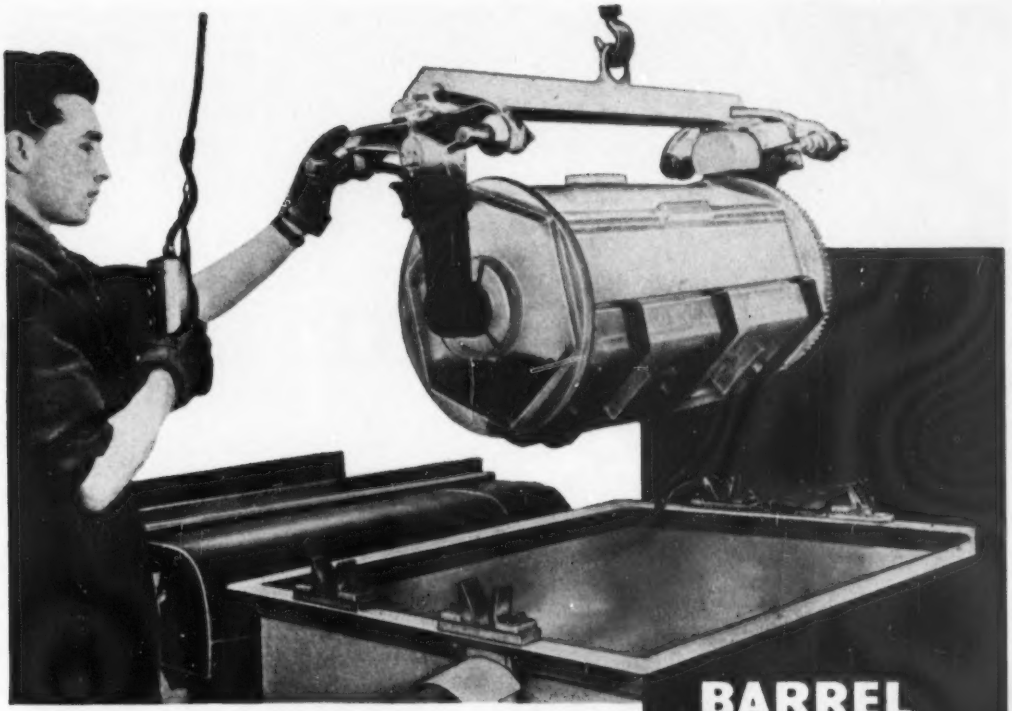

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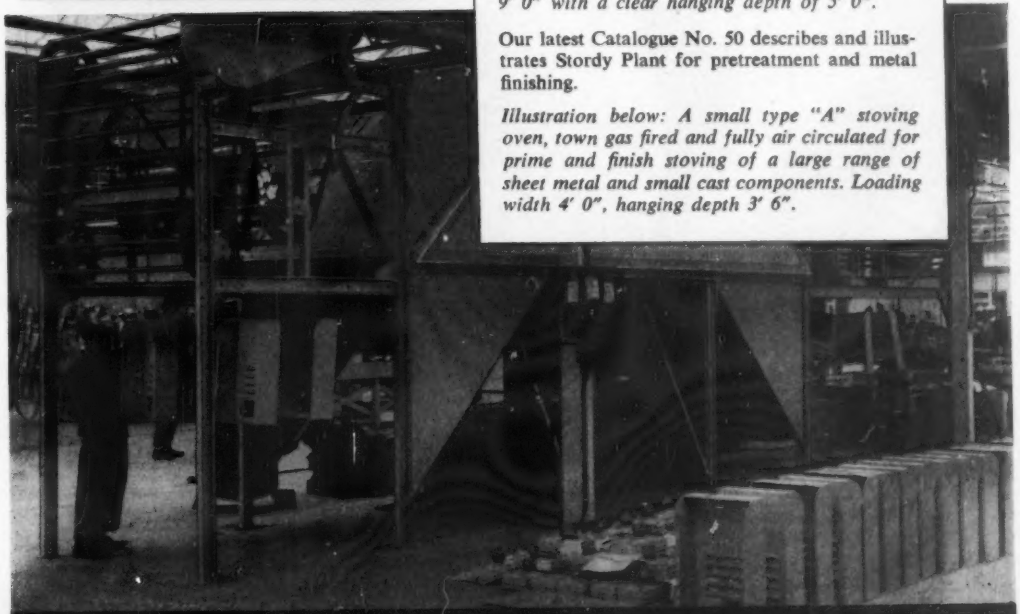

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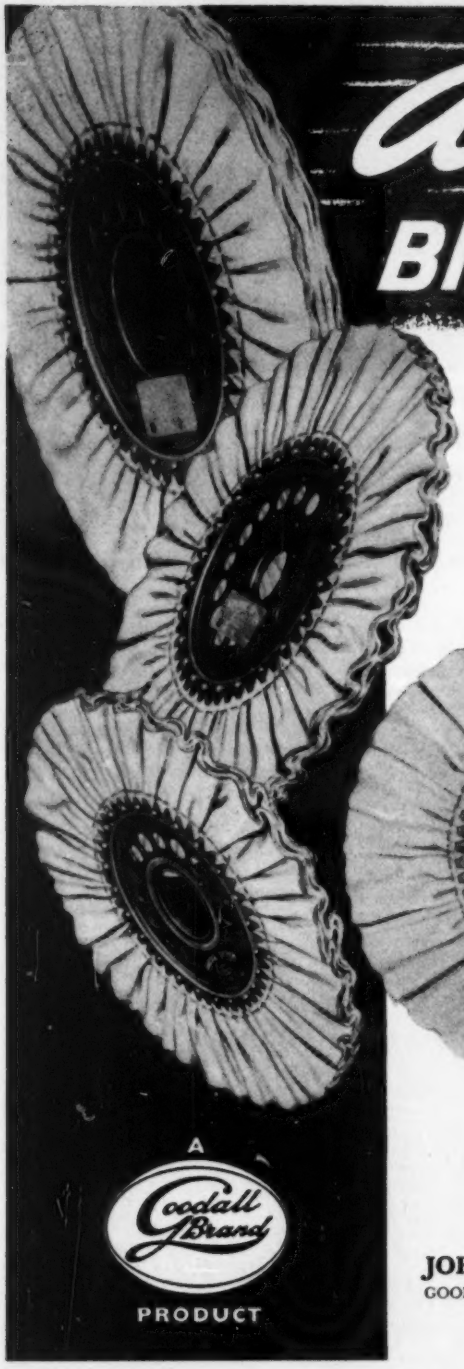

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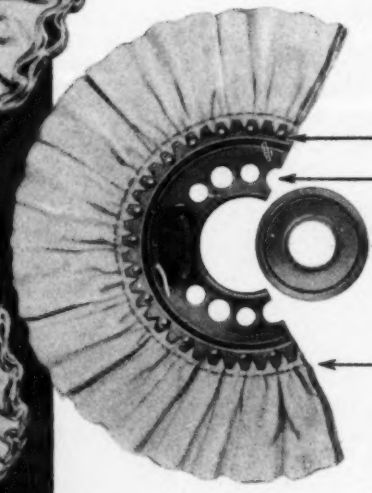
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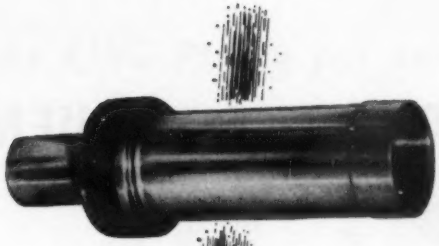

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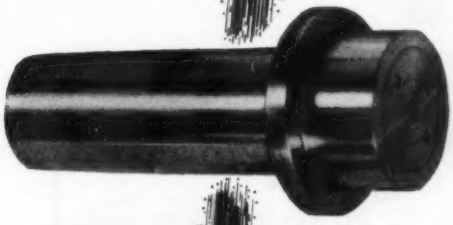

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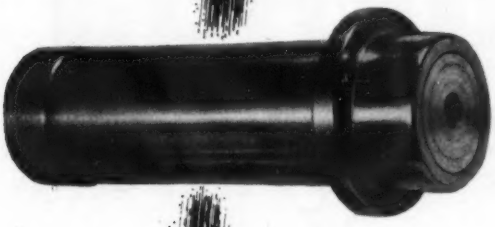

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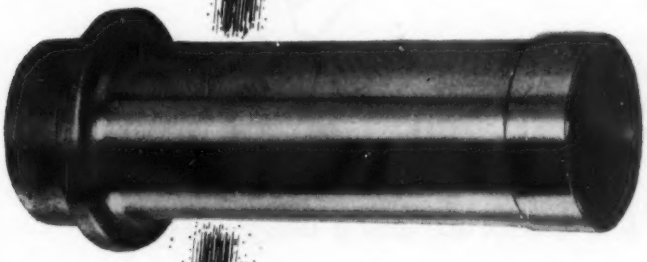

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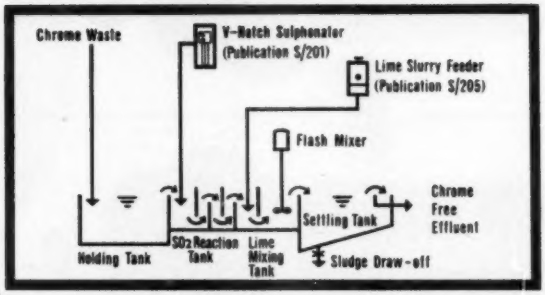

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metal finishing Journal

November, 1959 — Vol. 5, No. 59 (New Series)

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THIS JOURNAL IS DEVOTED TO THE SCIENCE AND TECHNOLOGY OF PAINT APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, GALVANIZING, ANODIZING, METAL SPRAYING & ALL METAL FINISHING PROCESSES. THE EDITOR IS PREPARED TO CONSIDER FOR PUBLICATION ANY ARTICLE COMING WITHIN THE PURVIEW OF "METAL FINISHING JOURNAL" AND ALL SUCH ARTICLES ACCEPTED WILL BE PAID FOR AT THE USUAL RATES.

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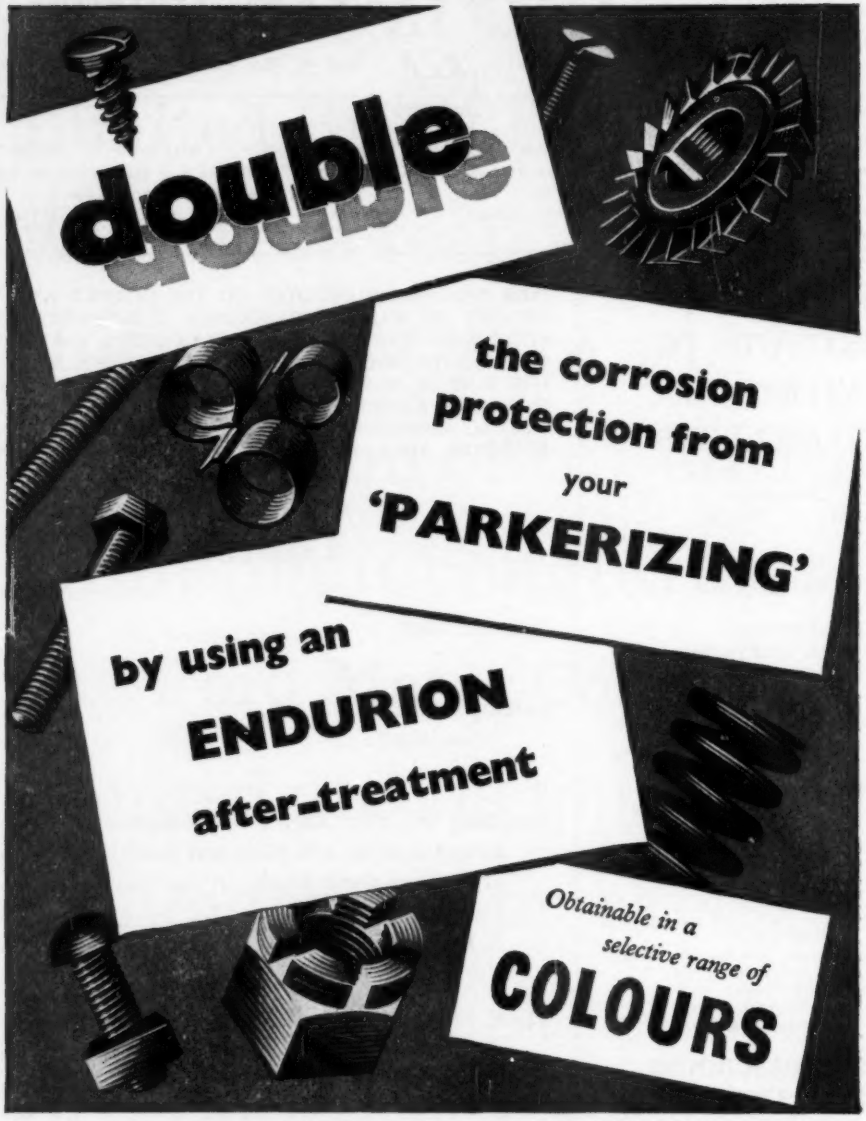
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ACTION AT LAST

ON several occasions in the past, the most recent being last June, reference has been made in this Journal on this page and elsewhere to the fact that a great deal of nickel/chromium plating is putting up such an inadequate performance in service as to bring about the very real danger of the finish being brought into widespread disrepute.

For many years decorative electroplated coatings had to live down the charge of being a tawdry substitute for the more noble metals. This era passed and nickel/chromium plating gained acceptance as an attractive finish in its own right, and its applications extended and multiplied greatly.

Came the war and diversion of nickel supplies, and post-war strategic stockpiling of nickel with resultant shortages, culminating in a statutory limitation on the range of articles to which nickel could be applied. Added to these were rising costs of production and the demand for higher production rates. These, and perhaps certain other less excusable factors, all contributed to a falling-off in the standard of performance put up by nickel/chromium plating in the post-war years.

Not unnaturally complaints became more frequent and, as might be expected, the purveyors of competitive finishes and materials were not slow in making attempts to exploit the sagging reputation of the rival finish.

While the physical shortage of nickel continued and the demands of production were maintained there was little that the plating industry could do to dispel the growing image of inadequacy which was being created in the mind of the consuming public, save to give voice to an occasional rebuttal of the more flagrantly disparaging criticisms when a suitable opportunity presented itself. Even in this however, nickel/chromium plating was at a disadvantage in that it lacked any organized and coordinated campaign to bring before the public its own side of the story.

However, with the availability of adequate supplies of nickel for all purposes for the first time since 1939, a champion has at last stepped into the lists in a bold attempt to re-establish and uphold the fair name of nickel/chromium plate.

This fact was announced at a special meeting convened jointly by the Mond Nickel Co. Ltd., and the British Standards Institution on November 10. This meeting occurred too late for reference to be made to it elsewhere in this issue and full details will be given next month, but it is of such potential value that immediate comment on this page is called for.

The project rests fundamentally on three basic concepts ; specification, inspection and classification. These comprise a revised British Standard Specification " Electroplated Coatings of Nickel and Chromium " (B.S. 1224:1959) which provides for thicker nickel deposits graded according to the type of service, together with the inclusion of a new and more stringent range of performance tests ; the commercial availability of the thermo-electric, non-destructive plating thickness gauge developed by the British Non-Ferrous Metals Research Association, and greatly improved since the prototype instrument was first described in this Journal over four years ago; and finally what may well prove to be the most enlightened development of all, the inception by the Mond Nickel Co. Ltd. of a labelling scheme whereby manufacturers can indicate on their products that the plating is to specification and is fit for service in the indicated environment. It is to be hoped that this bold step forward in an attempt to vindicate the character of nickel/chromium plating will receive from industry the support and encouragement it appears to deserve.

Talking Points

by "PLATELAYER"

TOPICAL COMMENT FROM THE MAIN LINES AND SIDE LINES OF METAL FINISHING

THE AUTOMATIC EXHIBITION

THE proposals made by the Federation of British Industries for a new ten million pound Exhibition Centre in London, prompts one to enquire whether, taking the long view, the Trade Exhibition as we know, it with its rows of stands and more or less well informed attendants, will survive indefinitely.

In this stream-lined age the trade show is, in fact, rather inefficient and in twenty years time there may well be other means of achieving the same objects. A large amount of temporary and expensive construction work is involved in putting an Exhibition on, and the problems of travel and hotel accommodation for visitors are full of frustrations. For the exhibitor, the manning of stands is also not easy to arrange. On the one hand, to put top level men in attendance all the time means that their work must suffer, and moreover, the work is exhausting and to a large extent time-wasting. On the other hand, having relatively junior staff in attendance may do more harm than good.

Perhaps the newly introduced automatic information unit may lead to fresh thinking on the subject of exhibitions. This is, in fact, a portable stand which not only displays exhibits, but answers questions from a tape recording in response to the dialling of a code. Moreover, the answers are more likely to be correct than those emanating from some Exhibition Stand attendants ! The machine will even deliver leaflets, if required, on pressing a button.

We may perhaps soon see a permanently open fully automatic exhibition centre covering an entire industry, always up-to-date, quiet, uncrowded and efficient.

WHO PAYS FOR CORROSION?

AT a recent meeting on the economic aspects of corrosion, Dr. E. C. Potter put forward the somewhat unusual viewpoint that more corrosion education might actually be undesirable as it may lead the unscrupulous to an exploitation rather than to a prevention of corrosion, and that some corrosion research will be carried out to stimulate higher profits by increasing the corrosion rate of manufactured articles to just that stage where the customer cannot validly complain.

There is much woolly thinking on economic aspects of production generally. The sum total of all human activities merely consists of moving components of the earth's surface from one place to another. Sometimes widely dispersed natural materials are brought together, like gold in Fort Knox, or "irrecoverably" dispersed, like the chromium on a scrap bumper. Yet, if course, no materials are ever truly lost, and if it is sufficiently worth while, means of recovering them can usually be worked out.

Corrosion preventive methods which result in excessive life may well be uneconomic. Many products today become obsolete before they wear out, and in fact the prosperity of numerous industries is highly dependent on the creation of obsolescence. Much nonsense is also talked about the "waste" caused by corrosion, as if great prosperity would accrue to all if it could be eliminated. To take a typical example, the replacement of cisterns and hot water cylinders is estimated to cost the country some £7 million per annum. If by waving a wand, all these cisterns could be made to last for ever, it is true that householders would gain this amount of money each year, but the makers of cisterns, galvanisers, plumbers and transport workers would lose it. And as all these people are also householders in any event, this is where we came in !

"SUMMAT FOR NOWT"

WHILE the technical press is always on the look-out for new information of interest to readers, it is remarkable how reticent some companies are in supplying details of new developments. It is often the large companies which are most secretive, possibly because of the complicated channels through which "releases" have to pass.

Technical articles are the supreme example of "something for nothing" to firms introducing new products, as was emphasised recently by Dr. N. A. de Bruyne, founder of Aero Research Ltd. He said that the first "break" his company got was as a result of a technical article and that the Dowty company got its start in a similar way.

He went on to say:"What has always struck one is the extent to which, at least in this country, the editorial staff of the press is divorced from the department that sells advertising space ! This is of great importance to a small firm because it means that a contribution of real interest will be treated entirely on its merits in the editorial part of the paper irrespective of the size of the firm."

FINISHING THE NEW ANGLIA

A Comprehensive Description of the

NEW PLANT AND FACILITIES

Installed at the Dagenham Works of the FORD MOTOR Co. Ltd.

Compiled by E. H. LLOYD, A.I.M., A.C.T. (Birm.)

THE £75-million expansion programme begun in 1954 at the Dagenham Works of The Ford Motor Co. Ltd., is now nearing completion. Out of the complete programme, which included a new foundry, new press shop, extensions to the old press shop, die stores, tool room, spare parts depots and the conversion of what was formerly Briggs Motor Bodies main works (now Ford Body Manufacturing Group) for the production of bodies up to the "in-white" stage, the largest single item has been the construction of a new P.T.A. (paint, trim and assembly) building, Here the painting, trimming and final assembly of the complete range of Ford cars (including the new Anglia) will be carried out.

Site of New P.T.A. Building

The site chosen for the new P.T.A. building was that of the company's sports field which had an area of 48 acres and lay to the east of the body plant and to the north of the existing main Ford plant. This site gave good road and rail access, but the decision meant that new facilities had to be provided for the sports club, and a new club house and sports field was constructed at Goodmayes, about 3 miles from the Dagenham plants.

The New P.T.A. Building

The new building, excluding the facilities block and the receiving bay has a ground floor area of 1,215 ft. by 540 ft. in which trimming and final-assembly operations are carried out.

Above this floor, which has a clearance headroom of 18 ft. except in certain suspended areas devoted to toilets and tool-crib blocks, the paint shop is located with an area of 1,080 ft. by 450 ft.

On the south side of the ground floor a covered unloading bay 45 ft. wide by 1,035 ft. long is provided with direct entry to the factory for the placing of bought-out items on to the various assembly lines. In addition engines, transmissions, front and rear suspension units from the chassis bay are unloaded here.

Projecting from the main building at roof levels are plant rooms which house the air-conditioning plants. The facilities block is part 3-storey and part 2-storey, and the employees enter the building by this block and thence by subways under the final assembly lines. Adequate modern canteen facilities are provided.

Ancillary buildings are provided for a Deminrolit plant, de-rusting set-up, compressor house, paint-mixing plant and these generally are of the same construction as the main building.

Storage compounds for new vehicles are provided at the east end of the site and in the delivery agents' area on the north side. A storage compound for export vehicles will also be provided. The total area will make provision for 4,500 vehicles.

Conveyor Bridge

From the reorganized body-manufacturing plant, bodies in-the-white are delivered to the paint shop in the new P.T.A. building by means of a conveyor bridge which has a total length of 725 ft. with a clear internal width of 18 ft. and a clear minimum height of 10 ft. The bridge is suspended on reinforced concrete portal frames with legs over 2 ft. 6 in. square at their base. Spans of girders form the sides of the bridge structure.

In order to prevent condensation the sides and roof cladding of the bridge have been carried out in wood-wool slab 2-in. thick, and the bridge is heated and the humidity is maintained at a constant level.

METAL FINISH

Completed body shells less doors, hoods, and boot lids, are conveyed from the body assembly ground floor to the metal-finish section on the floor above. Doors, hoods, and boot lids, etc. are conveyed separately to this floor, access being through holes provided in the floor. At the opposite end of the metal-finish floor is the entrance to the 725-ft. conveyor bridge leading to the paint shop.

The metal-finish section is laid out to take all models in production, *i.e.*, new Popular, Prefect,

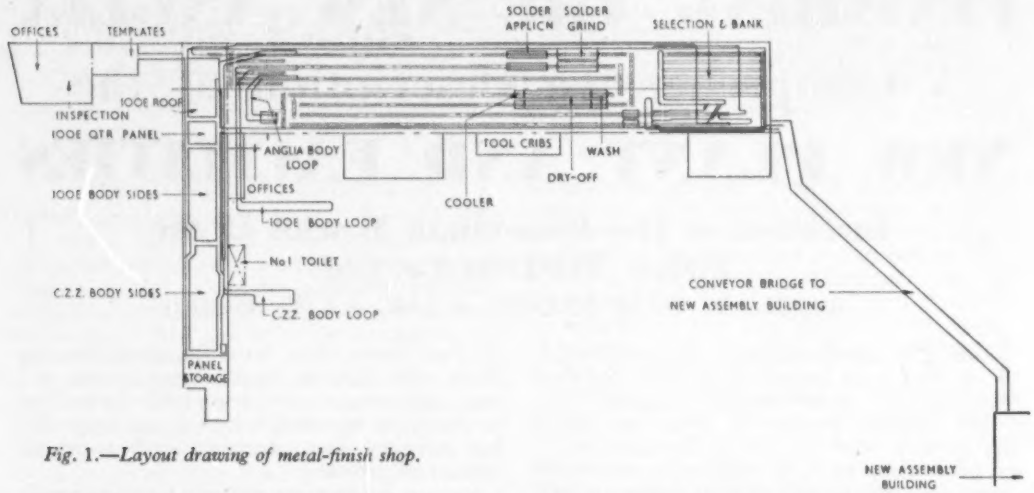


Fig. 1.—Layout drawing of metal-finish shop.

new Anglia and the Consul, Zephyr, Zodiac series. Of these bodies, the new Anglia requires no solder filling treatment, and therefore this line is not provided with solder booths. The other tracks, of which there are two, incorporate solder dressing booths of special design.

All bodies pass through a two-stage washer before painting in which a mild phosphate treatment is also given.

The general sequence of operations for those bodies requiring soldering is as follows : The bodies progress on skids, on the floor conveyor, and any small final brazing or welding operations are first carried out ; grinding down of any welds is also done at this stage.

The doors, hoods, boot lids and fenders are then added to the body and final dressing prior to soldering is then carried out in enclosed, screened areas. The bodies then go into the solder canopies, where the torch soldering operations are effected.

The next operation is to disc the soldered areas in the special booths. These are designed to have a large influx of air from the shop so that there is no exhaust into the shop, *i.e.*, there is no possiblity of solder entering the shop atmosphere. In fact, one-third air is drawn from the shop. Air is drawn down into the booth by means of a fan and in its passage past the body collects solder dust. This is carried downwards to a grated floor under which a certain amount of solder settles in trays. The air then passes into a water-wash section outside the booth from which the air is extracted to atmosphere by a further fan. In the input duct a glass-fibre filter is provided. This type of booth whose efficiency is very high (about 98 per cent) is manufactured by Drummond Patents Ltd.

After solder discing the bodies pass to a two-stage washer manufactured by Modernair (Processes) Ltd. The first stage is an alkali clean consisting of sodium hydroxide and sodium carbonate together with additions of trisodium phosphate, pine oil, sodium silicate and wetting agents.

The second stage is normally a rinse. This washer system which is operated at a temperature of 160°F. is steam heated.

For bodies which have to be kept in store for longer than 8 hours (*i.e.*, over the weekend) the rinse stage is normally omitted as the mild phosphate and the pine oil offer adequate protection from rusting, before the bodies pass into the 6-stage phosphate plant in the paint shop.

After the two-stage washer the bodies go into the final line for touch up and inspection, after which they are passed into a selection and storage area. Here they are removed from the floor conveyor and their skids, and pass on the overhead King " Dual Duty " conveyor through the conveyor bridge into the paint shop.

As with the paint shop the conveyor systems run from end to end in the metal finish section, automatic transfer of the bodies at the end of one line to the beginning of another being provided. This type of conveyor is described fully in the following details on the paint shop.

PAINT SHOP

The paint shop takes up the whole of the first floor of the new P.T.A. (paint, trim and assembly) building and covers 437,000 ft. The unpainted body shells are received on the overhead Dual Duty conveyor from the Body Manufacture Group building at the north west corner of the building. The paint shop, in principle, consists of two main systems of equal size. For the sake of clarity one system only will be described.

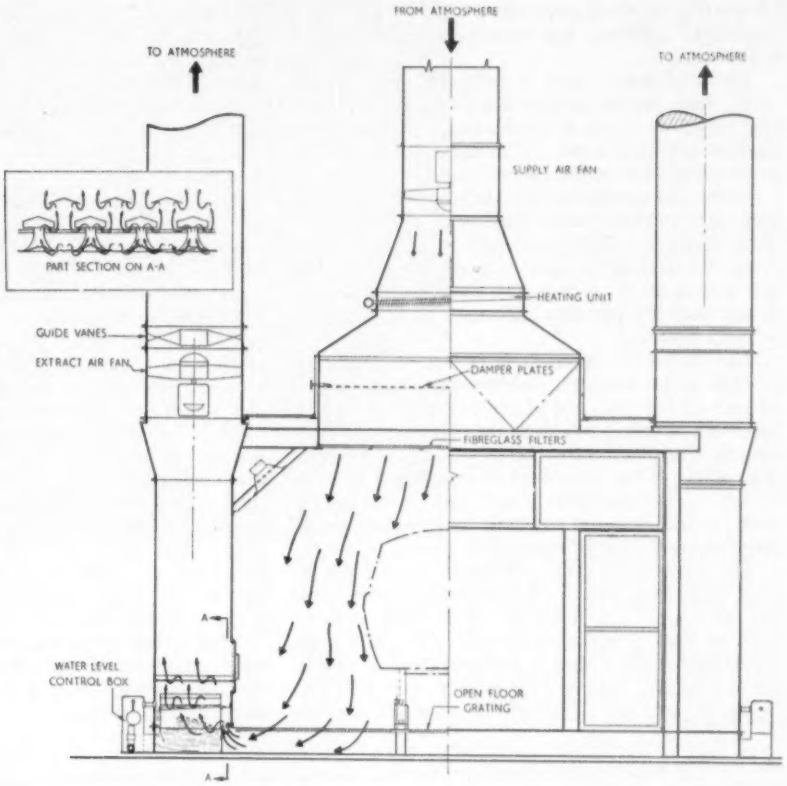


Fig. 2.—Diagram of solder - discing booth in metal - finish shop.

The main delivery conveyor feeds into a buffer storage area and the bodies pass through here on an overhead conveyor at a speed of 20 ft. per min, over a pre-clean deck for an anti-rust treatment and manual clean-up operation before passing at 10.8 ft. per min. into a six-stage phosphate coating plant. The length of this is 164 ft. and the processing time 15 min.

The entry end of the plant is a 16-ft. vestibule, the first stage being alkaline cleaning with Pyroclean No. 4; there are 312 spray jets each handling 2.7 gal. per min. from a pump of 900-gal. per min. capacity. The alkali clean section is 12 ft. long.

A reservoir tank positioned directly below the housing has a capacity of 3,800 gal. and is maintained at a temperature of 170°F. by means of steam-heated coils. This is followed by a drain section, 16 ft. long, and the first hot-water rinse, having 192 spray jets each handling 2.7 gal. per min. served by a pump of 550 gal. per min. capacity. This section is 7 ft. long. The reservoir tank which is positioned directly below the housing has a capacity of 2,300 gal. and is maintained at a temperature of 170°F. by means of steam-heated coils.

Then follows a drain section 16 ft. long, and a second hot-water rinse of identical specification, a further drain section and then the phosphate (Bonderite 160) stage which is 12 ft. long.

This stage consists of 180 jets each handling 5 gal. per min. and served by a pump of 900 gal. per min. capacity. The phosphate solution is maintained at a temperature of 160°F. by means of steam-heated coils. The reservoir tank, which has a capacity of 4,900 gal. has been specially designed to remove the phosphate sludge formed in the phosphating process. The bottom of the tank has been formed with six cones, each approximately 6 ft. deep, from the bottom of which the sludge is slowly drawn off by means of a stainless-steel centrifugal pump; the sludge is discharged over an automatic paper filter which filters the sludge from the liquor, allowing the clear liquor to drain back to the reservoir tank. The pump filter medium automatically winds itself on when fully loaded.

The phosphate stage is followed by a 16-ft. drain section and then a cold-water rinse having 192 jets each handling 2.7 gal. per min. and served by a pump of 550 gal. per min. capacity. The

reservoir tank sited underneath the housing has a capacity of 2,800 gal. and is not heated ; the section is 7 ft. long.

The cold-water rinse is followed by a further 16-ft. drain section and then a 7-ft. long chromate rinse section, which is of identical specification to the first hot-water rinse. This latter tank, however, is supplied with demineralized water.

In the exit vestibule, 16 ft. long, there is a single ring demineralized water rinse with a slight chromate additive. This final rinse is pumped direct from the Deminrolit plant (described later) and is not recirculated. The water from the final rinse drains into the previous chromate tank, acting as a water make-up.

The Bonderite solution is stored in 1,500-gal. storage tanks mounted beneath the drain section of one of the two phosphate plants. The filling pipework to this is run from the paint-mix building outside the plant were there is a delivery pump. The whole of the pipe-work is in plastic Durapipe tubing. The chemical from the bulk storage tanks is fed into the reservoir tank by means of stainless-steel chemi-feeders and plastic pipework.

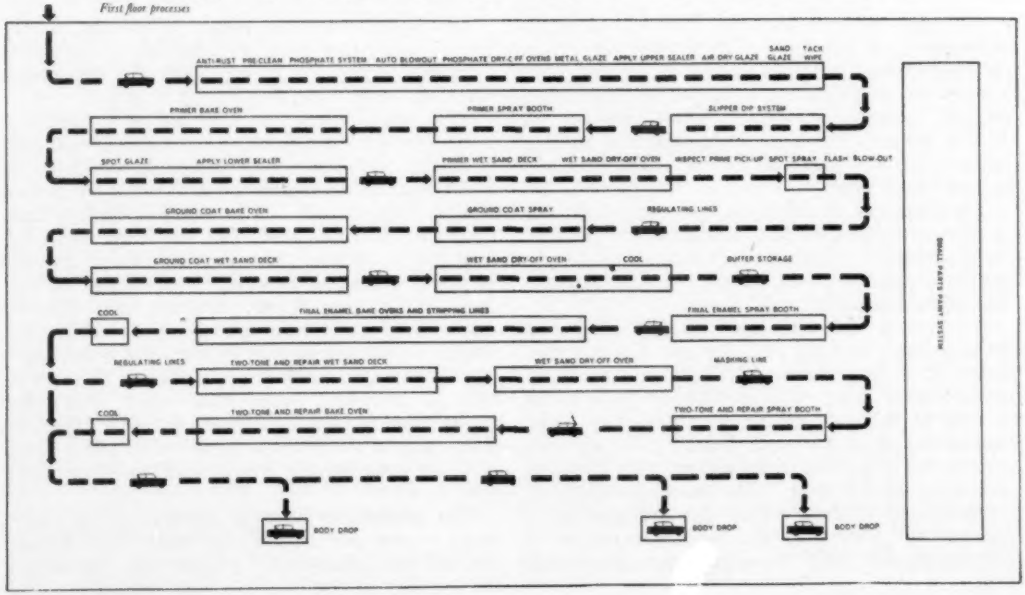
The phosphate plant is followed by a blow-off deck 51 ft. long, and this is followed by a phosphate dry-off oven. The oven is 156 ft. long with an 8 ft. air seal in addition at each end. The oven will maintain the bodies at a temperature of 325°F. for at least five minutes, the total time in the oven being 15 minutes. The oven is heated by recirculating air, which in turn is supplied by gas-fired direct Scroll-Aire heaters. From the two such heaters on this oven, having a total capacity of 6,000,000 B.Th.U. per hour, the ends of the oven are heat sealed by means of efficient fan-powered high velocity air seals. The oven is followed by an efficient cooler 20 ft. long, with axial flow input and extract fans.

After the phosphate oven and cooler, it is possible to by-pass the bodies on to storage conveyors running back alongside the ovens. The purpose of this conveyor is to allow the bodies to be stripped from within the phosphate machine when there is a break in production. The bodies in the oven pass on to the storage lines and the bodies in the phosphate machine pass into the phosphate oven ; this will prevent the formation of rust on bodies during production breaks.

In the ordinary course of events, bodies after leaving the phosphate oven and cooler pass on to raised open decks where the upper dust and water sealing and glaze operations are carried out. The sequence is metal glaze, apply upper sealer, air-dry glaze, sand glaze and tack wipe. The conveyor speed on this deck is 10.8 ft. per min. At the side of this deck is the room for the mixing of the primer, ground coat and slipper dip paints.

After a pick-up operation at the end of this deck the bodies pass on their overhead conveyor round the end of the shop and enter the underbody (slipper) dip system.

Fig. 3.—Simplified layout and flow diagram of paint shop. Only one of the two lines is shown here.



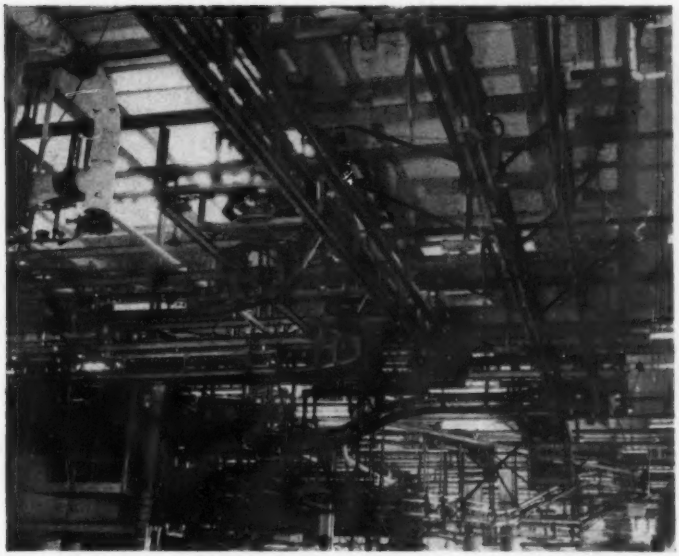


Fig. 4.—Overhead entry conveyors in the paintshop. Bodies from the conveyor bridge from the metal-finish shop divide on to two conveyor systems which pass through two separate finishing systems in the paint shop.

This system consists of a dip tank 30 ft. long with a capacity of 3,200 gal. of paint and followed by an enclosed drain tunnel 160 ft. long. The paint from the dip tank is continuously re-circulated through filters to remove any impurity. As a further precaution there is a large dump pipe running from the base of the dip tank down to large dump tanks sited in concrete pits under the ground floor. In the event of fire, this paint will be automatically dumped to the tanks below and at the same time a CO_2 system will discharge CO_2 gas into the whole length of the underbody dip enclosure the fans and pumps being simultaneously stopped.

After underbody dipping the bodies proceed on overhead conveyors to the primer spray booth. This booth, 90 ft. long, is of the down-draught type with 30-ft. entrance and 20-ft. exit vestibules. Each spray booth is served by two air-conditioning plants sited on the roof above each booth and each plant has a capacity of 80,000 cu. ft. per min. and consists of bird screen, motor-operated louvres, anti-frost heater battery, self-cleaning Ventex

Fig. 5.—Body entering phosphate system.

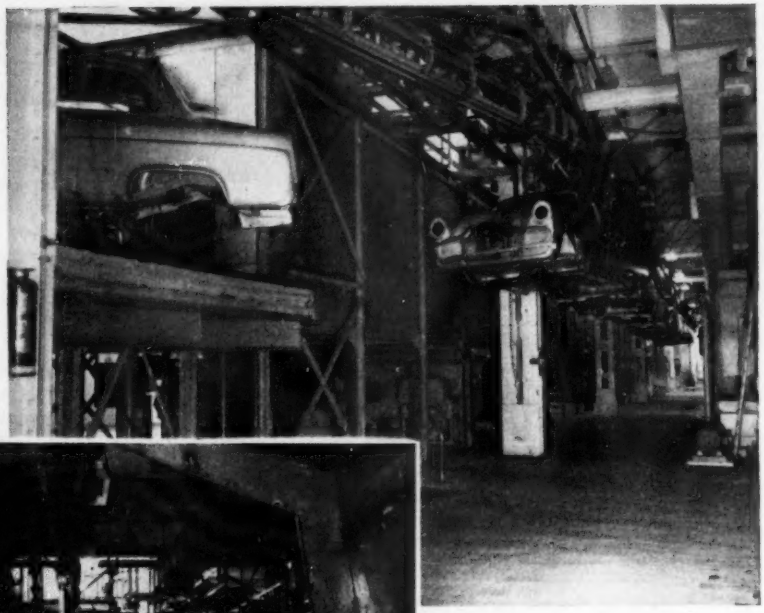


Fig. 6 (right) Bodies on phosphate dry-off oven stripping line.

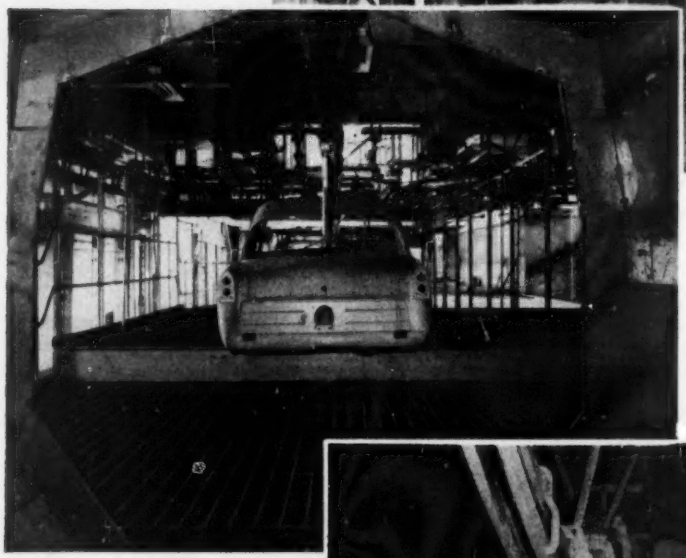


Fig. 7. (left). Upper sealer deck.

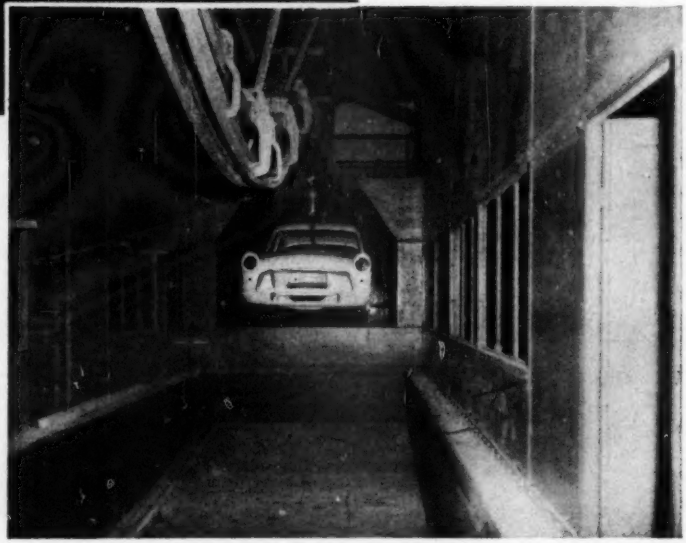


Fig. 8. (right) Interior of slipper dip.

Fig. 9.—Anglia bodies undergoing final rinse in demineralized water.

viscous filter, main air heater battery and centrifugal fan. From the fan, air is ducted to the top of the spray booth where it is discharged evenly along the whole length of the booth through secondary filters in the roof of the booth itself.

There is a very fine control on the air supply along the length of the booth, there being individual sliding perforated plate dampers every 2 ft. 6 in. along the length of the booth. Great care has been taken to remove any paint particles from the air extracted through the floor of the booth. This air is scrubbed in the Roto-Wash booth back which removes all the paint particles before the air is discharged to atmosphere. These paint particles form a large amount of sludge and a special sludge-handling plant (described later) has been designed to serve all the body paint booths. The booths and vestibules are lined with white Warerite sheeting with aluminium flashings and cover strips to give the operators the best possible working conditions.

Primer Bake Ovens

The bodies now enter the primer baking oven, 430 ft. in length, which will hold a peak temperature of 325°F. for at least 30 min. The oven is

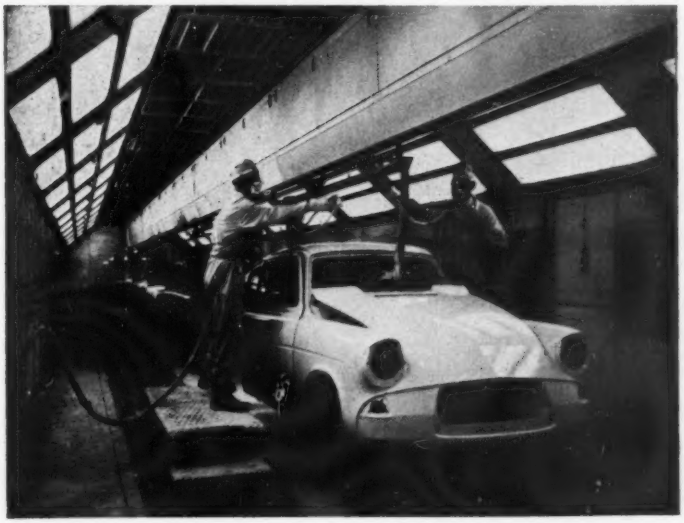


Fig. 10.—Anglia bodies in final enamel spray booth.

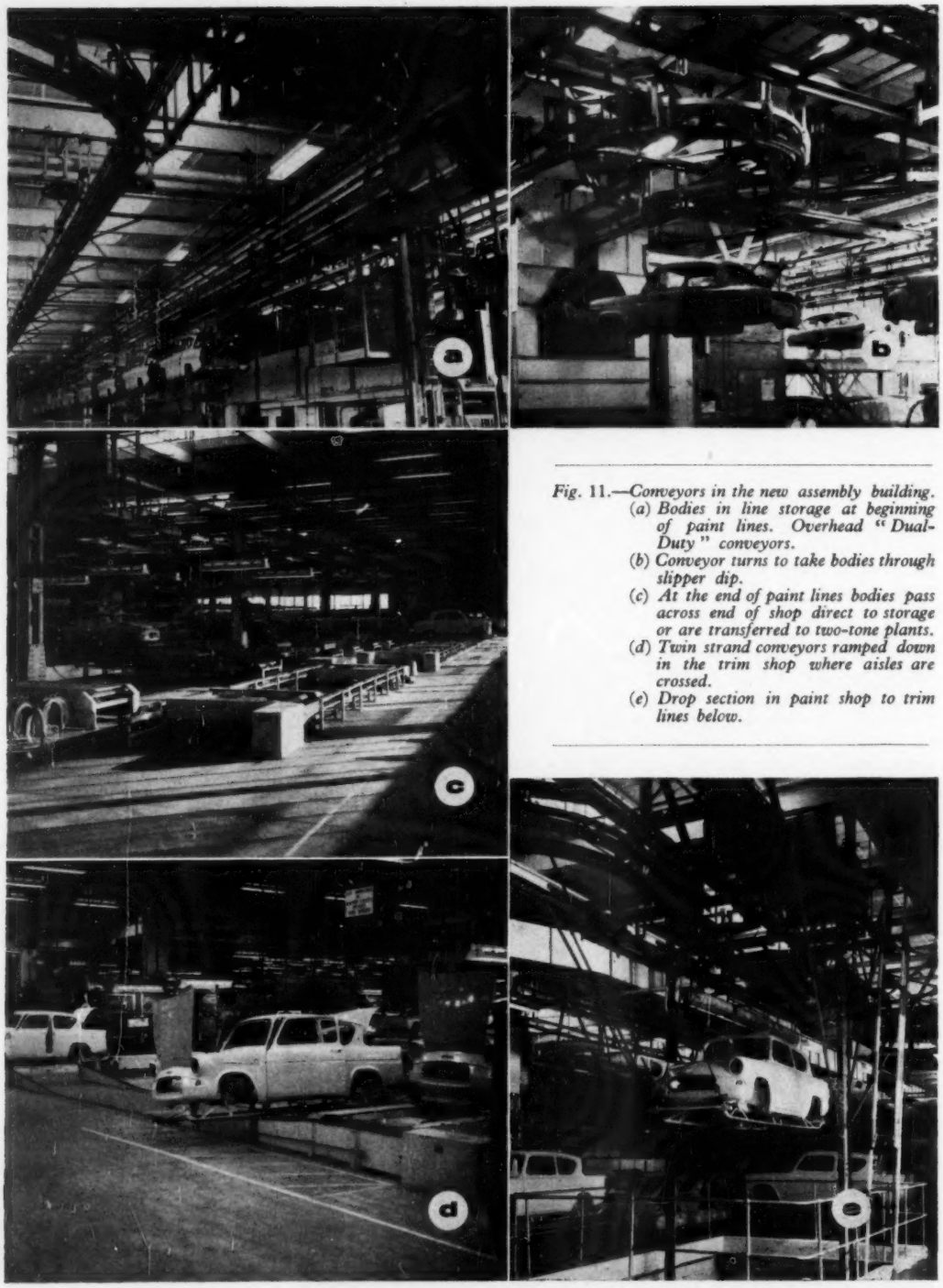


Fig. 11.—Conveyors in the new assembly building.
(a) Bodies in line storage at beginning of paint lines. Overhead "Dual-Duty" conveyors.
(b) Conveyor turns to take bodies through slipper dip.
(c) At the end of paint lines bodies pass across end of shop direct to storage or are transferred to two-tone plants.
(d) Twin strand conveyors ramped down in the trim shop where aisles are crossed.
(e) Drop section in paint shop to trim lines below.

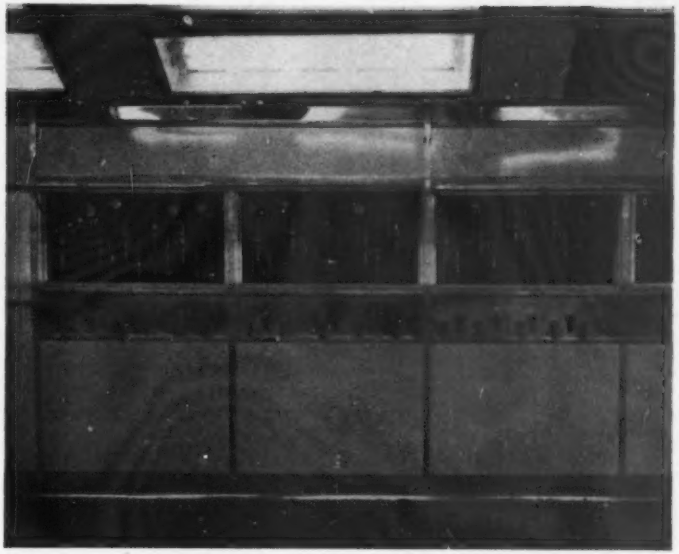


Fig. 12.—Interior of final enamel spray booth showing take off points for spray guns and pressure control valves for each line.

gas-fired in a similar manner to the phosphate oven and is served by four Scroll-Aire heaters having a total input capacity of 7,500,000 B.Th.U. per hour. The oven is followed by an efficient cooler.

Decking the Body

Up to this point the body has been travelling on a Dual-Duty overhead conveyor. Now two ski-type skids (cleaned in their own plant in the shop) are fitted to the underside of the body and then they proceed round the end of the shop and turn on to the new lines. The body is now dropped on to floor conveyors and it will remain in this type of conveyor for the rest of its journey. The first operation on the floor conveyor is spot glaze and ding followed by dust and water sealing operations. The bodies then pass on to the primer wet sand deck, 295 ft. long, which is fed by high-quality water. The conveyor speed is 10.4 ft. per min.

At the end of the wet sand deck there is a Deminrolit water rinse of the highest quality; the body is wiped and then passes into the wet sand dry-off ovens, 156 ft. long with air seals at

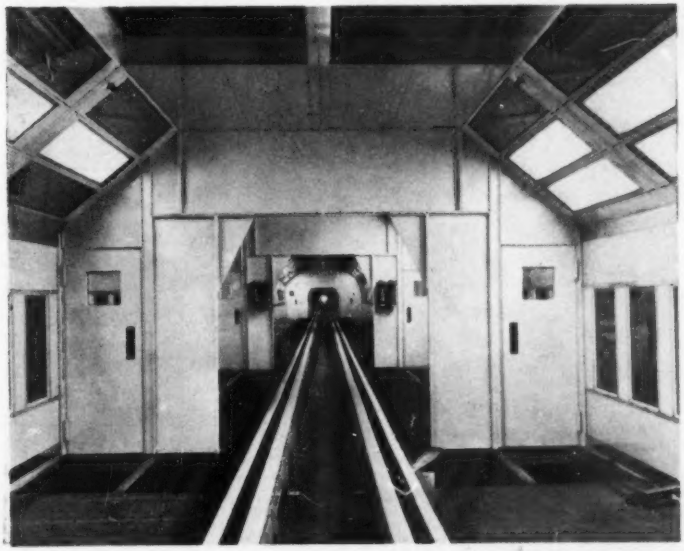


Fig. 13.—View down final enamel spray booth with bake oven in the background.

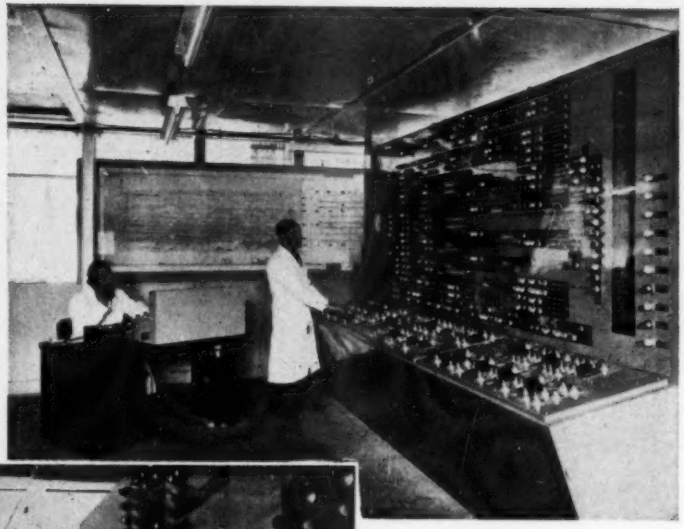


Fig. 14.—(right)—One of the two main control rooms in the P.T.A. plant. From this point on the first floor the flow of bodies through the entire paint system is tracked and controlled. A similar room on the ground floor controls all conveyors and transfer equipment in the assembly system. Supplementary control panels are sited around the plant where required, e.g., for the diversion of bodies onto repair conveyors.

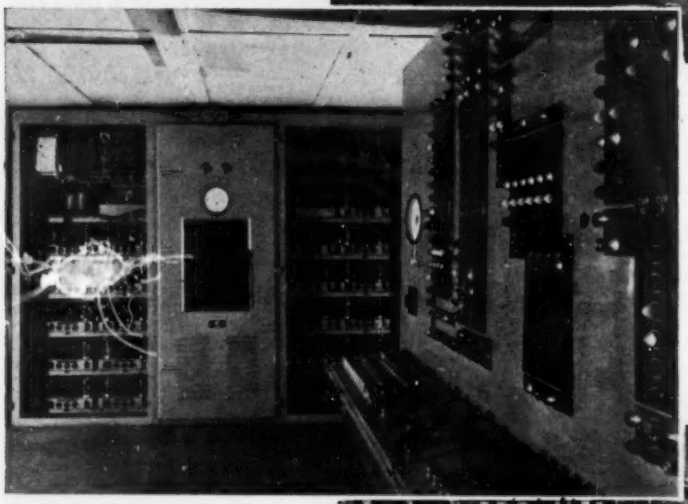


Fig. 15.—(left)—One of the two main control rooms in the new PTA building showing (right) the master control panel and (rear) Heenan-Dynamatic Coupling excitation units and speed trimming potentiometers.

Fig. 16.—(right)—From this panel the operator controls the selection and transfer of bodies between the primer, ground-coat and final enamel systems. Throughout the plant the mechanical transfer system is operated either by such local "consoles" or by one of the two main control rooms.

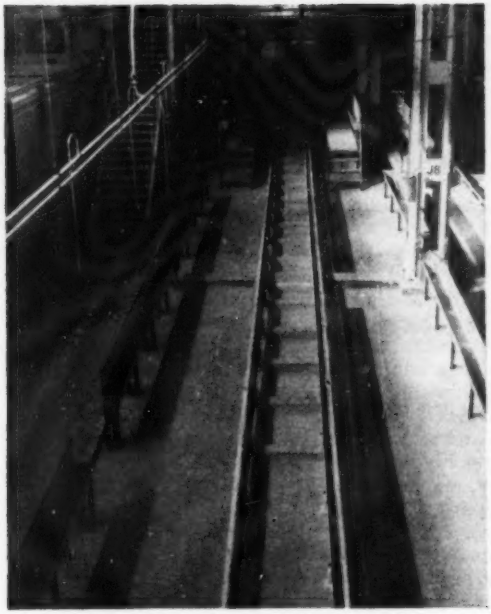


Fig. 17.—Wet deck conveyor in the paintshop.

each end, which is similar in size and equipment to the phosphate dry-off oven mentioned earlier. The drying time totals 15 min. with a 5-min. period at 325°F. Following the oven is a cooler section, 20 ft. long, and this is followed by an open deck where the bodies are inspected and any blemishes in the primer coat repaired. The sequence is inspect, pick up, spot primer spray, and flash off. The body then passes on to a turntable for turning through 180 deg. so that they will pass down the next lines through the spray booths in road position. The final operation here is a compressed-air blow-off.

The bodies then pass on to a horizontal auto transfer conveyor.

Ground-coat System

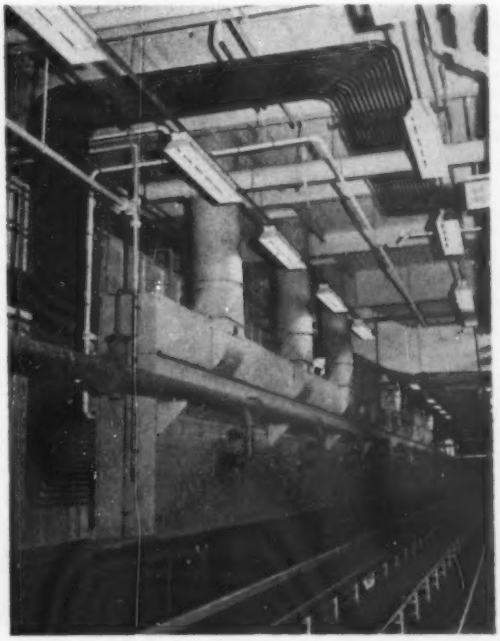
At this point, bodies can be split off from the two systems into a single ground-coat system. This system consists of a ground-coat booth, ground-coat oven, wet sand deck, wet sand dry-off oven and cooler, of a similar design to those described in the primer and wet sanding operations previously.

Final Enamel System

Bodies from both the primer and ground-coat systems now pass into one of two final enamel booths. Each final enamel spray booth consists of a 60-ft. entrance vestibule, 120-ft. spray booth and 30-ft. exit vestibule. This booth is served by three air-conditioning plants, each plant having a capacity of 70,000 cu. ft. per min. and each consisting of a bird screen, motor-operated louvre, anti-frost heater battery, self-cleaning Ventex viscous filter, Precipitron air filter, principal heater battery, two-bank warm water humidifier and a re-heat air heater battery and centrifugal fan. The humidity and temperature of the input air are both automatically controlled by a system of electronic controls supplied by Honeywell Controls. The air extraction and paint sludge removal are the same as for the primer booth.

After leaving the enamel booth, the bodies pass into steam-heated final bake oven, 599 ft. long with air seals at each end, and designed to maintain a temperature of 260°F. for 30 min. (total time in the oven 60 min.). The oven is heated by natural convection with gilled steam coils fed with steam at 200 lb. per sq. in. and having a total output of 4,870,000 B.Th.U. per hour. The oven is divided into eight zines, each zone being controlled by electronic thermostatic controls which operate modulating steam valves. The oven is fitted with efficient heat and air seals at each end and at the leaving end of the oven is a special vestibule 17 ft. long supplied with clean filtered air. This is followed by a cooler, 20 ft. long, after which there is

Fig. 18.—Enamel spray booth exterior showing paint feed piping.



an inspection deck. The conveyor speed in the oven is 9.8 ft. per min.

Finished bodies receive a rigid quality inspection; bodies which are required in monotone proceed by automatic conveyors to storage lines on the south side of the building. Bodies requiring two-tone are by-passed into one of two two-tone and repair systems. One system consists of a 208-ft. and the other a 140-ft. wet sand deck, demineralized water rinse and wipe off, gas-fired wet sand dry-off oven at 260°F., cooler, masking area, two-tone booth, baking oven, clean air vestibule, cooler and inspection deck.

The two-tone spray booth and ovens have the same high standard of air filtration and humidity control that is applied to the final enamel system. From these inspection decks the bodies now pass into the storage areas for transfer to the ground floor below where the trim and final assembly operations occur.

Small Parts Paint System

At the eastern end of the paint shop is an area devoted to the paint processing of the small component parts which are painted separately from the body. These parts are brought by pallet train *via* a lift from the ground floor and moved into a stock area. The small parts are selected from the stock and hung on an overhead monorail conveyor which passes through a six-stage phosphate machine of similar type to the body phosphating machine.

The tank and pump capacities are adapted for the individual line speed and type of part being processed.

After phosphating the parts pass into a phosphate dry-off oven and after the oven certain parts are removed from the conveyor for black-enamel dipping. These parts are loaded on to flight bars which pass over a black-enamel dipping tank, allowing the parts to become submerged, and then over a drain tray and finally up into an overhead gas-fired oven, 200 ft. in length, which maintains the parts at a temperature of 400° F. for a minimum of 35 min.

The dipping plant and oven are protected with CO_2 equipment and dumping arrangements in a similar manner to that described in the underbody dipping plant.

Parts not off-loaded for black-enamel dip pass on over an aisle and are then off-loaded for either primer dipping or primer spraying in a spray booth similar to the body spray booths, then through a primer bake oven followed by a dry sanding deck and finally through a final enamel spray booth which is 75 ft. long with 30-ft. entrance vestibule and 20-ft. exit vestibule.

After the booth, parts pass through a three-pass

Fig. 19.—*End of paintshop showing new Anglia body on the transfer conveyor system. The lift table in the foreground is shown in the raised position. All variable-speed Dynamatic controlled-slip couplings on the conveyors together with related electronic control gear were supplied by Heenan and Froude Ltd.*

steam-heated oven which will maintain them at a temperature of 260° F. for 30 min.

The air-conditioning plant serving the small parts enamel spray booth is similar in design to those serving the body final enamel spray booths, having the same high standard of filtration and automatic control.

The finished parts from the small parts system are then transported back to the ground floor by pallet train for distribution on the trim and final assembly lines prior to their being fitted to the car bodies.

In order to assist in maintaining a clean operation three washers, have been installed one for washing the overhead body slings which hold the body on the overhead conveyor, one for washing the ski-type skids which are later attached to the body, and the third for washing the small-parts hangers. Each washer consists of a long tank in which the part to be cleaned is immersed for a pass time of 5 min. in crysylic acid and after passing over a drain section, is rinsed once under high-pressure cold-water jets and once under high-pressure hot-water jets before passing to the loading areas.

Paint Sludge Handling System

As mentioned in the description of the paint shop the paint overspray in the spray booths is washed from the extract air and forms a paint sludge which has to be removed. A special sludge handling system has been designed to deal with this problem.

First of all the water in the system is treated with Peabody 5MS compound which causes the paint particles on mixing with water to form a floating sludge which is non-sticky. By arrangement of the pumps at spray-booth level, this floating sludge travels to the ends of the booth and here overflows down large-diameter pipes to join two main trunk pipes under the ground floor, which deliver the sludge and water into separating pits outside the south wall of the building.

There is one system for enamel paint sludge and one for primer paint sludge. The diameter of the main enamel sludge pipe being 24 in. and the primer 20 in. ; each system feeds into a long underground concrete tank, 110 ft. long by 10 ft. wide by 8-ft. liquid depth. There is also a third spare tank into which either system can be diverted.

After the sludge and water has entered the west-end of the tank, it is induced to flow to the east end. At the eastern end the floating sludge is skimmed off the top with a solid flight conveyor, the sludge being deposited in reasonably solid state, for reclamation or disposal, into conveyors.

From the lower part of the eastern end of the tank, clear water is drawn by two pumps, each handling 1,800 gal. per min. and returned to the spray booths on the first floor, where the returned water forms an excess which causes the sludge to flow over the weir back to the underground tanks. Each pump system is equipped with one stand-by pump. The underground sludge pits are mechanically ventilated to prevent the formation of fumes given off from the paint sludge.

General Information

The total capacity of the gas furnaces installed is 73,000,000 B.Th.U.

The total capacity of immersed heating coils is 66,000,000 B.Th.U. per hour.

The total capacity of oven heating coils is 22,500,000 B.Th.U. per hour.

The total length of oven heating coils is 5¼ miles.

The total capacity of spray booth air conditioning plants is 1,504,000 cu. ft. per min.

The total length of spray booths and vestibules is 1,440 ft.

The total length of ovens is 6,000 ft.

The total weight of steel sheet and structural steel used is 2,600 tons.

The capacity of each of the six pumps is 1,800 gal. per min., motor h.p. for each pump is 100.

The total length of sludge pipework is 6,000 ft.

The specification and inital design was carried out by the Plant Engineering Department, Body Manufacture Group, Ford Motor Company.

The detail design was carried out by John Lysaght's Bristol Works Ltd., Lysaght-DeVilbiss Division, and under the supervision of the Ford Plant Engineering Division.

Installation of the entire paint equipment was carried out by Lysaght-DeVilbiss Division of John Lysaght's Bristol Works Ltd.

The Aerograph-DeVilbiss Co. Ltd., engineered the complete paint circulating system including two paint mixing rooms and 11½ miles of pipeline, with 842 take-off points, each of which is fitted with a regulator to ensure correct fluid pressure at the spray gun. Over 600 Aerograph-DeVilbiss Type JGA spray guns are used to apply undercoats and enamels, and paint heaters are installed in the primer booths to control viscosity, enabling the paint to flow more easily and a heavier coating to be applied in one operation.

Undercoating Mixing Room

The primer, primer-surfacer, ground coat and underbody dip coating are maintained at the correct consistency in seven paint mixing units. Each unit comprises two 100-gallon galvanized steel tanks fitted with powerful air-operated circulating pumps and reciprocating action paint agitators. The two tanks are connected to one circulating pipe line and either tank can be cut out of the circuit for refilling or servicing without causing any interuption in the flow of paint.

Fig. 20.—Final enamel mix room.

Enamel Mixing Room

Because of the large number of colours used in the spray finishing stations the enamel mixing room is on a very much larger scale than the undercoating system.

The mixing room contains thirty 100-gallon tanks connected in pairs feeding fifteen individual enamel circulating systems. Thinners are piped direct into the mixing room from four 1,500-gallon underground storage tanks and are added to the mixing tanks through meters to reduce the enamels to the required consistency.

Provision has been made to ensure that the paint is kept in a thoroughly mixed condition and is prevented from settling out and clogging the pipe lines during week end and holiday breaks by the installation of two Aerograph-De Vilbiss compressor plants. One delivers 200 cubic feet of air per minute and is powered by a 44-h.p. electric motor, the other has a 15-h.p. motor and

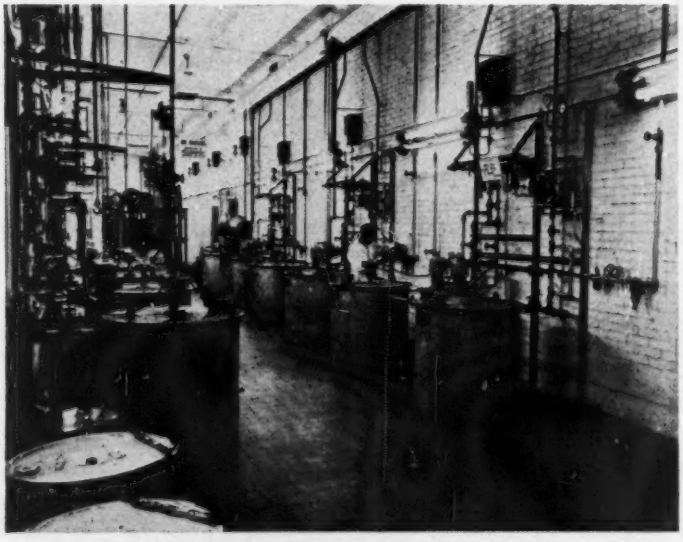


Fig. 21.—Primer paint mix room.

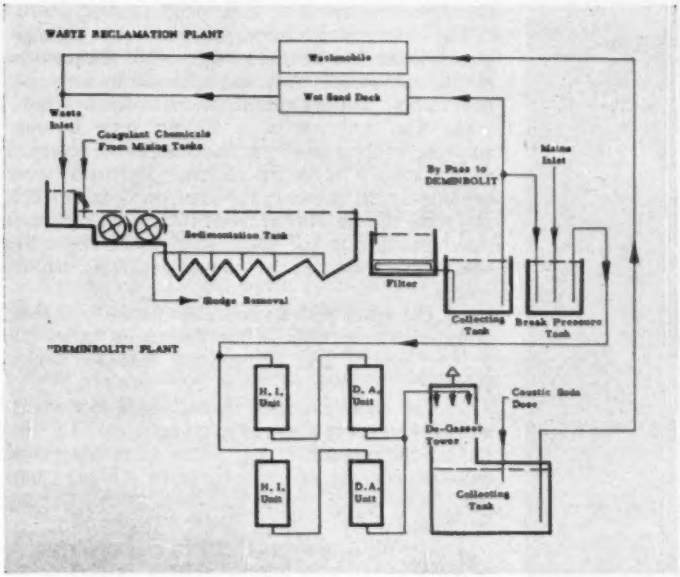


Fig. 22.—(left)—Diagram of water-treatment plant.

delivers 50 cubic feet of air per minute.

These compressors cut in automatically when the main compressed air supply is closed down and they keep all paint agitators and fluid pumps operating so that the paint circulation is maintained at a reduced pressure and speed.

WATER TREATMENT IN THE PAINT SHOP

In designing the new paint shop those responsible were faced with two major water requirements, as follows :—

(1) The provision of a constant flow of highly purified water at the rate of approximately 6,000 gal. per hour, to be piped to a number of points where they would provide rinses virtually free from water solubles.

(2) Provision of a supply of mains quality water at the rate of 25,000 gal. per hour for the sanding decks where the primer surface paint which provides the base for the application of baking synthetic enamel is sanded down to give a smooth surface.

Deionized Water

Mains water, although taken from a number of supply sources, normally contains a relatively high content of soluble salts in the form of calcium, magnesium, and alkali metal carbonates, chlorides, nitrates and sulphates. Home station supplies contain as much as 734 parts per million. Blended Stour water contains of the order of 400 parts per million.

Experience and much research has shown that normal mains water when allowed to dry freely on a surface will deposit its water soluble content on to the drying surface, the actual point of deposition occurring when after evaporation, the solubility level of the particular salt has been reached. Such salts being hygroscopic, are capable of absorbing water through subsequently applied paint films, when the resulting increase in volume and hydrostatic pressure is sufficient to break the adhesion of the paint film and cause local blistering. Thus, the quality of water used in the rinsing of bodies through various production stages is of extreme importance.

In order to obviate the possiblity of contamination on bodies by hard water salts, therefore, it has been necessary to specify a water of high quality for body rinsing during production stages with a specification as below :—

Total solids	23 ppm. max.
Chlorides	10 ppm. max.
*p*H value	5 to 6
Conductivity before CO_2 removal	15 to 20 micromhos.
Conductivity after CO_2 removal	9 to 15 micromhos.

Water to this specification must be piped to rinses after phosphating and to rinses after wet sanding operations.

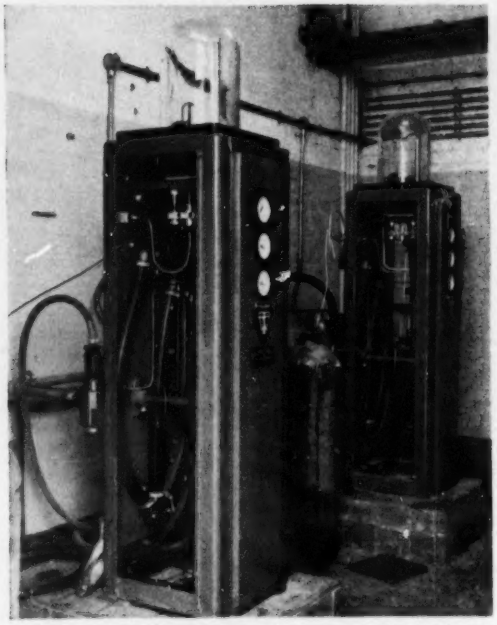


Fig. 23.—Chlorinator and sulphanator dosing units in water treatment plant.

To give this quality, mains water is treated in an ion-exchange Deminrolit unit of Permutit manufacture consisting of the following resin exchangers:

Zeocarb unit—for removal of cations—chiefly metal ions.

Deacidite unit—for removal of the acid content formed during removal of cations.

These units require regeneration after treating approximately 69,000 gal. of hard water. Regeneration of the Zeocarb unit is conducted by passing hydrochloric acid through the spent resin, followed by back washing, while the Deacidite unit is regenerated by passing a solution of sodium carbonate through the spent resin followed by back washing.

Although regular chemical control is exercised, minute by minute observation of the conductivity meter indicates the quality at any time, and regeneration is undertaken when the maximum conductivity figure is exceeded.

Mains Quality Water

The provision of a volume of mains quality water for sanding decks at the rate of 20,000 to 25,000 gal. per hour presented supply difficulties, and it became necessary to instal a recirculating system from the wet sanding decks. In recirculation of such water two problems required to be met. First, treatment against the build-up of bacteria and second the removal of very finely divided solids in suspension, resulting from paint sanding debris.

The bacteria problem was met by chlorine injection into the returned water, while the removal of the suspended solids was achieved by chemical flocculation, settling and filtration, as follows :—

(*a*) The addition of a 10 per cent ferrous-sulphate solution and 5 per cent lime to the returned water forms a flocculant of ferric hydroxide after oxidation with chlorine, the lime being added first to create the correct *p*H conidtions. This treated water passes into the flocculation tanks where the operation is assisted by slowly revolving paddle wheels.

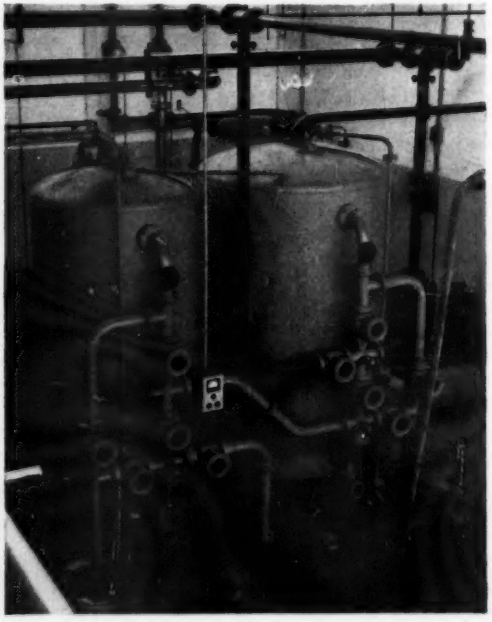
(*b*) The water with its flocculant passes to settling tanks where the bulk of the flocculant settles out to the bottom and is removed through sludge valves.

(*c*) The water is passed through sand filter beds. and is then ready for recirculation.

The chlorination of the water gives a residual chlorine content of approximately 0.1 per cent, but if this figure should be exceeded then it may be reduced by sulphur-dioxide injection.

The make-up of losses of the recirculated water is achieved by draining into the system the demineralized water used for final rinsing at the end of the wet sand decks. Thus there is a gradual increase in the overall quality of the water in the recirculation system, and this stabilizes after a few weeks' working.

Fig. 24.—Zeocarb and Deacidite units in Deminrolit plant.



A proportion of this treated water is also put through the ion-exchange unit in place of mains water, thus helping to reduce the cost of producing the demineralized water by extending the life of the resin between regenerations.

Handling of Painted Parts

Small painted parts are handled in special-purpose stackable trays which give full protection to the surface by separating each piece between plastic pegs. The trays are reworkable for future part changes.

Mechanical handling in the paint shop is carried out by two flameproofed (to Buxton standards) fork-lift trucks. Paint is received in 40-gal. drums having removable lids. It is stored in gravity racks which ensure stock turnover. After mixing, the paint is pumped to the painting booths.

SERVICES

Gas

The gas service is supplied by the North Thames Gas Board with an 18-in. gas main feeding the building. The estimated gas consumption is 150,000 cu. ft. per hour approx., which is principally used for the heating of dry-off and paint baking ovens on the first floor of the building. This consumption is equal to the gas supply for a town of 35,000 inhabitants.

Compressed Air

There are two compressed-air systems within the building. One system is served by four 2,000-cu. ft per min. balanced opposed-piston Alley and McLellan compressors which supplies the general compressed air to the whole factory. This air is piped to the factory through a 10-in. compressed air main which serves a 6-in. ring main running around the ground floor at high level from which a main branch distributes the air to the various take-off points. Where there are a large number of small air tools being used on one main branch, this air is automatically lubricated with Norgren Micro-Fog lubricators.

The second system consists of three 1,000-cu. ft. per min. reciprocating Alley and McLellan compressors of the carbon ring type which supplies completely oil-free air for paint spraying purposes. This second system is fitted with a Burnett and Lewis fully automatic " Humidryer " which ensures that the air supply for paint spraying is moisture-free as well as oil-free. This compressed air is piped to the building through a 5-in. main with branches to serve each spray booth on the first floor, splitting down to individual air points at each spray station within the spray booth.

Water

The original water consumption for the building was estimated at 40,000 gal. per hour. The majority of this water was to be used on the body wet sanding operations and would then have to run to waste. It was decided, however, to reclaim this water used on the wet sanding decks and therefore the clarification and Deminerolit plant was installed as described previously.

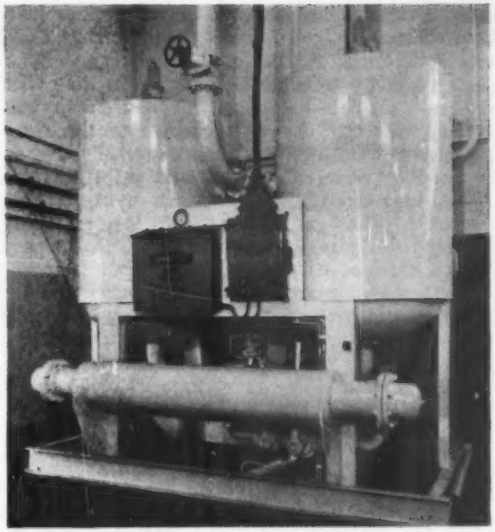


Fig. 25.—The " Humidryer " for the compressed-air supplies.

The water supply is fed from the Ford estate storage tanks, situated near the south-west corner of the site. This main is purified at the base of the storage tower and is piped by an 8-in. underground main to the building. This main is then piped either direct to drinking water points or to six tanks room on the roof for distribution to the various water points. Each tank room contains two Braithwaite tanks each of 2,750 gal. capacity.

Steam and Condensate

Steam is supplied to the building at two pressures, one at 200 lb. per sq. in. and one at 100 lb. per sq. in. This steam is back-pressure steam fed from the generating turbines. The 200 lb. steam is piped into the building through a 6-in. main and branches to service five final enamel paint baking ovens. The 100 lb. steam is piped to the building through a 16-in. steam main and splits into several circuits. One circuit serves the phosphate machines, sling and skid washers and roof level air conditioning plants. Another circuit serves the ventilation plants used for heating and ventilating the ground floor. Condensate is returned through three mains, one main being for the condensate from the 200 lb. steam, one for the condensate from the 100 lb. steam, which cannot be contaminated such as air conditioning and ventilation plants, and the third main for the condensate from the 100 lb. steam which is liable to contamination should a heat

exchanger fracture, such as those in phosphate plants and skid cleaning plants. There is an electronic detecting device fitted to the condensate main liable to contamination so that in the event of contamination occurring this condensate will be run to waste and not returned to the main power house. All the condensate normally returns to two large receivers, each receiver is 9 ft. dia. by 27 ft. long overall, and each has a capacity of approx. 10,000 gal. Before this condensate is returned to the main power house the flash steam has to be removed. This is done by a heat exchanger which warms the clarified water and by thermostatically controlled air coolers mounted directly above the condensate tanks. These coolers consist of three finned-tube heat exchangers which are served by axial flow fans handling 40,000 cu. ft. per min.

General

There are 34 miles of pipe used in all the above services.

The design of the filtration and Deminrolit plant was carried out by the Permutit Co. Ltd., in conjunction with Posford, Pavry and Partners. The design of all the other services was by Posford, Pavry and Partners. The installation of the filtration and the Deminrolit plant was carried out by G. Percy Trentham and J. Jeffreys and Co. Ltd, The installation of the entire gas, water, factory compressed air, steam and condensate mains was by J. Jeffreys and Co. Ltd. The installation of the paint shop compressed-air pipework was by Aerograph-DeVilbiss.

Heating and Ventilation

The main building is heated by ducted warm air. The principal system being on the ground floor since the first floor heat loss is normally balanced by the heat gained from the process ovens. Thirteen plant rooms serve the ground floor and these are arranged in alternate bays along the north wall of the building on the first floor. Each plant room contains two plants, one rated at 60,000 cu. ft. per min. for summer ventilation, and one rated at 20,000 cu. ft. per min. for heating and ventilation in the winter. Each plant consists of adjustable louvres, Ventex viscous filter, air heater battery and centrifugal fans. In the case of the winter plants, they are electronically controlled by a system of Honeywell Controls supply consisting of three averaging room thermostats, two compensating air thermostats, one for installation in the discharge duct and one in the fresh-air intake, all controlled from an electronic relay panel which in turn controls the modulating steam valve. The summer plants have a heater battery for use on spring and autumn nights, and this is controlled by controls of Rheostatic Co. manufacture, each comprising a modulating steam valve duct to give constant air temperature supply. The combined winter plants give an air change of 1½ air changes per hour to the whole of the ground floor, and during summer the combined winter and summer supplies give a total air change of 5½ per hour to the ground floor. This air input is balanced by extract ducts which run in the alternate bays to the input duct system. In areas where there is only a single storey building the extract duct is omitted and roof extract units are used instead. Added to the extract ventilation is air extracted by the comprehensive car fume exhaust system and wax spray booth, which is taken into account when balancing the air input. The fume exhaust system is placed over the final production lines where the car engines are run prior to leaving the factory. Each car exhaust has a tube fitted to it which runs in a rail above, the exhaust passing through this tube for extract to atmosphere by a system of ducts and axial flow fans having a total capacity of 350,000 cu. ft. per min.

Particular attention has been given to keep the heat within the building, delivery lorries to discharge their load come right into the south side of the building. These lorries enter and leave by air locks, each air lock having double doors so that the outer set must be closed before the inner set will open.

At the south-east corner of the building there are two doors which will be permanently open to allow the finished cars to be driven out of the building These doors have been fitted with a combined hot air curtain and air seal. Each of these plants is served by two centrifugal fans handling 12,000 cu. ft. per min. and each served by two heater batteries each capable of 1,000,000 B.Th.U. per hour.

Ventilation to the first floor has been designed to give six air changes in the areas in which operators are working, and individual systems have been placed on the roof of the building to serve each location. Each plant consists of a Ventex viscous filter, heater battery and centrifugal fan on the larger plants, and Vokes Kompak filter, air heater battery and axial flow fan on the smaller units. The total air capacity on the units on the first floor is 320,000 cu. ft. per min.

Heating to the facilities block is carried out by means of a low pressure hot water heating system with a ventilating system to serve the lower floors which do not have natural ventilation to all sides' Heating to the ancillary buildings is by low pressure steam radiant panels and unit heaters.

The design of the heating and ventilation was carried out by Posford, Pavry and Partners. Installation of the entire ventilation and car fume exhaust was by Andrew Air Conditioning Co. Installation of heating and ventilation services to facilities block and ancillary buildings was by Hobdell Engineering.

The total length of ducting installed on the ventilation plants is 5½ miles. The total weight of sheet metal work is 600 tons.

Metal Finishing Technology — A Students' Guide: 2

An Introduction to the Examination Syllabus in Metal Finishing of the City and Guilds of London Institute

Compiled by A. ALEXANDER

PHYSICAL METALLURGY AS APPLIED TO METAL FINISHING

Structure of Metals

THE elements can be roughly divided into two categories, metals and non-metals. Metals are usually distinguished by the fact that they are malleable and ductile, conduct electricity and have a particular appearance. It is not possible to draw a completely hard line because there are a number of substances which have some metallic properties but are not usually classed as metals.

It is very important that the structure of a metal should be thoroughly understood by those who work on it. If a piece of metal is broken and the fractured surface examined, it will be seen that it has a crystalline appearance; a polished metal surface etched slightly in acid will also show a crystalline structure (see Fig. 3). These crystals of course are not regular crystals like a crystal of washing soda but have irregular sides. However, they are true crystals in that the atoms composing them are arranged in a regular lattice structure.

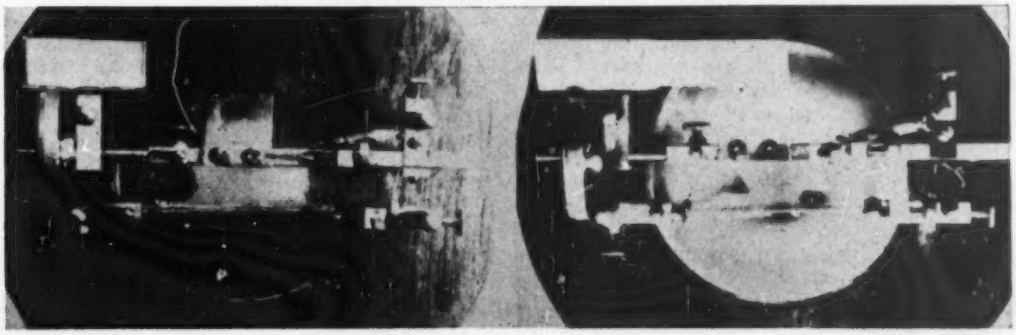
In a crystal the atoms may be regarded as being arranged in rows. The arrangement is quite regular and standard for any particular material although it varies between different metals. There are a number of different systems in which these atoms can be arranged, for example, face-centred cube, body-centred cube, close-packed hexagonal, etc. Sometimes a metal may crystallize in more than one system.

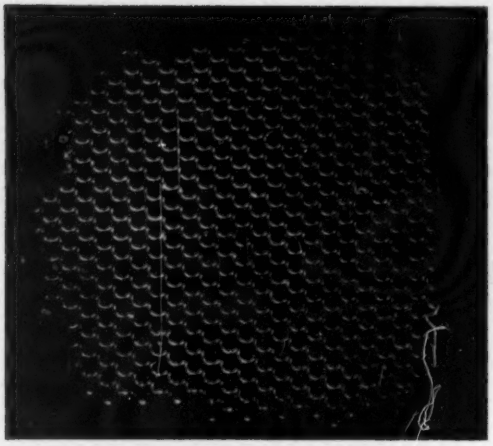
An experiment has been devised to give a picture of this structure. A small trough of soapy water is used and a number of small bubbles are blown so that they remain on the surface of this. These bubbles form into a natural lattice which reproduces the type of structure in a metallic crystal (Fig. 1).

If two small pieces of metal are put into the trough to form ends and then squeezed together or drawn apart, the bubbles will slightly deform at first, but with increasing pressure will ultimately move one with relation to the other. If the pressure is applied across the lattice from two opposite corners it will be seen that for a time a certain stress is set up in the bubbles but with increasing pressure one plane of bubbles suddenly shifts with relation to the one next to it. If the pressure is released before this happens the bubbles will go back to their original position but afterwards they will not do so but the bubble lattice will be permanently deformed.

This is exactly what happens in a metal crystal. If force is applied to the crystal it will for a time yield only a slight amount and if the force is released

Fig. 1.—Apparatus for simulating deformation of metal lattice by means of soap bubbles.





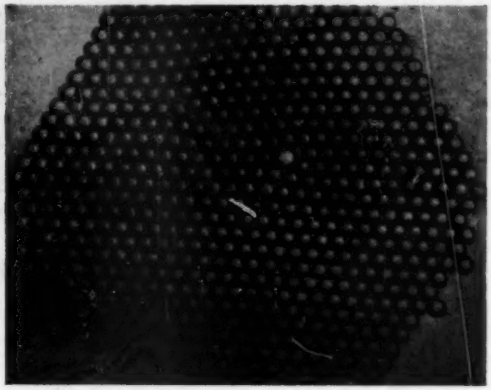
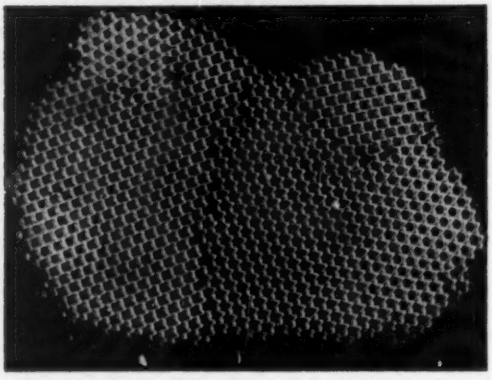


Fig. 2.—Simulation of lattice structure of metals by a raft of soap bubbles. (Above) Unstrained lattice. (Above right) Imperfect lattice showing dislocation. (Below) Deformed lattice with dislocation planes exhibiting crystal structure.



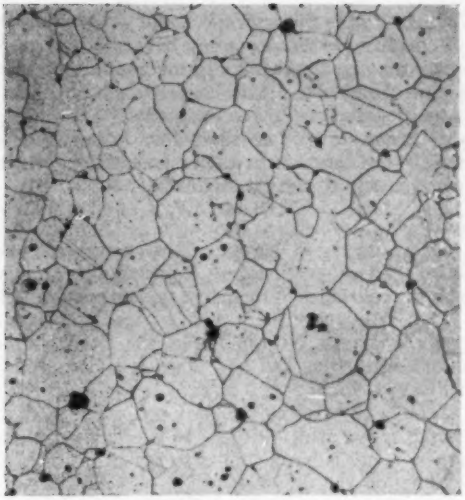
it will return to its original shape. With increasing force, however, the crystal will be permanently deformed. This property is called the modulus of elasticity or Young's modulus. The metal can be stressed up to this modulus without permanent deformation, that is to say it is slightly springy. The extent to which a metal can be stressed depends both on the metal itself and the condition which it is in, for example, a piece of spring steel properly tempered can be bent through a considerable angle and still return to its original shape whereas a piece of lead, even with a slight bend will not spring back to its original shape.

In the first place, therefore, it should be remembered that a metallic crystal is a piece of metal in which all the atoms are arranged in an orderly manner. It does not usually look like a crystal of copper sulphate or washing soda, that is to say the outer faces may be quite irregular. The crystal can be distorted by applying a force to it and in such cases it will usually slip along the lines of the atom planes.

If a piece of metal is polished and etched and carefully examined the crystal boundaries will show up and usually different crystal faces will etch slightly differently, thus giving a differential pattern on the surface. This method makes the study to the crystal structure of the metal possible ; it may be composed of large or small crystals and the crystals may be regular in shape or elongated in a particular direction.

Fig. 3 shows such a structure. In this case the metal has been annealed and the crystals are roundish and regular. In Fig. 4, on the other hand, the crystals are long shaped. This specimen is taken from a metal which has been electrodeposited and the crystals have grown out on the cathode face in the form shown ; in this case the metal is fairly soft. Fig. 5 shows a composite deposit having a soft deposit at the bottom and a much harder one on top. It will be seen that the top part of this has a much finer crystal structure and in general the finer the crystal structure the harder the metal.

If a piece of soft metal, for example a piece of annealed copper, is hammered, the crystals are broken up so that on examination the structure will be found to be composed of much smaller crystals than the original sample. The result of this is that the metal becomes harder, that is to say more difficult to deform. If, on the other hand, a piece of hammered copper is heated to a red heat and allowed to cool, the crystals will be found to have again grown to a larger size and the copper is softened. In general, the larger the crystal the softer the metal because it is easier to deform a single crystal than it is an aggregate of crystals where the crystal planes are all in different directions and



therefore tend to resist deformation in any one direction.

It is important to form a mental picture of this structure and what happens when the metal is worked or heat treated. At a high temperature it is possible for a crystal to grow at the expense of those surrounding it ; that is to say the atoms of the smaller crystal will re-orient themselves so that they form part of the larger one. In forming any such picture, however, it must be remembered that the above description is an over-simplification of the actual facts. Although for convenience atoms can be represented as small spheres whose position is fixed in relation to one

Fig. 3.—(Above left) Large regular crystal structure characteristic of an annealed metal.

Fig. 4.—(Above right) Elongated crystal structure characteristic of soft electrodeposits.

Fig. 5.—(Right) Composite deposit showing a fine grained and therefore hard layer superimposed on a softer, larger grained metal layer.

another, in point of fact at normal temperatures all these atoms are in rapid motion and the position usually ascribed to them is really only that position where they are most likely to be. It must be remembered therefore that while these analogies are extremely useful, they must not be pressed too far. Crystals are not usually perfect, that is to say there are points in them where an atom is missing or perhaps an atom of some other material present as an impurity is squeezed into the lattice, distorting it. In some cases also there are what is known as dislocations, places where the lattice does not fit properly, one plane upon another.

From the point of view, however, of the metal finisher it is important that he should realize the general structure of the metal but it is not necessary that he should have any great knowledge of the atomic structure. If he realizes that the metallic crystal is composed of atoms arranged in an orderly manner and that under certain circumstances these planes of atoms may slip over one another, and also that with increasing temperature the vibrations of the atoms would increase so that they may migrate somewhat, through the structure, this will generally be sufficient for the purpose in question.

The atom itself is of course an extremely complex unit and is composed of a central nucleus built up of protons and neutrons together with a number of electrons circulating around it. Of these electrons some of those in the outer shell of the atom are able to circulate from one atom to another and it is in fact these electrons that carry the electric current through the metal. It is also these circulating electrons which bind the whole metal together.

Metals conduct electricity and they do so by the motion of the electrons through the lattice so that there is no actual movement of the atoms themselves. Plating solutions on the other hand, do not conduct in this way but the electrons are carried across the solution by atoms or groups of atoms called ions so that when an electric current is passed through them, matter is actually moved. This is a fundamental difference between the two types of materials. It is possible to think of the electron as a person walking down a path to a river. When he comes to the river he gets into a boat, rows the boat across and lands on the other side. In this case the person is the electron and the boat is the ion, that is a charged atom or group of atoms. At the end the boat will of course be left on the other side of the river and this is what happens when a current is passed through a solution of a metal salt, the atoms being carried across the solution and left at the opposite side.

Mechanical Properties of Metals

Turning however to metals, these have certain mechanical properties, the chief being the ultimate tensile strength, hardness and ductility.

Ultimate Tensile Strength

The ultimate tensile strength means the stress which must be applied to a given cross-section of a metal to fracture it. This can be tested by making a special test-piece of known diameter and pulling it in a machine. The force that is required to break it can be measured and the ultimate tensile in lb. per sq. in. can be calculated.

Hardness

This property of hardness is a somewhat more difficult one to define but is usually considered to be the resistance of the metal to deformation. If a steel ball is put on a piece of lead and then a weight balanced on top of it, the ball will be squeezed into the lead and when it is removed it will leave a small round mark. If the same thing is done with a piece of hardened steel there is practically no mark visible. In the latter case we say the metal is hard, that is to say it has resisted deformation by the ball.

This type of test was one of the original hardness tests, known as a Brinell test. It is more usual now to use a diamond pyramid and to force this into the metal surface by means of some type of small hydraulic press. For very thin coatings an extremely small point and a comparatively light weight is used the indentation so produced being examined under a high power microscope ; this is usually called a micro-hardness test. There are other methods of testing hardness depending on the same type of properties for example a scratch can be produced on a piece of metal by drawing it under a point which has been loaded to a known amount ; the width of the scratch is then measured. The metal surface can also be abraded with a specified abrasive under a standard load and the loss in weight of the specimen measured ; that is to say determine how much of the metal has been abraded away. These various methods do not always give comparable results because the properties actually being measured are usually somewhat different, and in expressing the hardness of a metal it is necessary to say how it is measured.

The figures obtained also are only comparative ; there is no actual hardness measurement, and all that can be done is to compare measurements made by a particular apparatus on different specimens.

When dealing with electroplated coatings a micro-hardness test is normally used. A diamond-shaped point is used and the figures obtained are very similar to the Vickers Diamond Pyramid and can usually be expressed in Vickers hardness numbers or V.H.N. For some purposes scratch hardness tests have been used but it is doubtful whether they have much to recommend them.

Ductility

The ductility of a metal is a measure of the amount by which it can be deformed without

fracturing. This is usually expressed in percentage elongation, that is to say a percentage of its own length to which it can be pulled out without starting to crack. A measure of the elongation can be obtained on the tensile test described above. The test-piece has usually got large ends, the centre portion being smaller and of the required diameter. The amount that this centre portion elongates at the point of fracture can be taken as a measure of the ductility. Another measure can be obtained by measuring the final diameter at the break and see how much this has reduced from the original diameter of the test-piece.

While this method is suitable for measuring the ductility of a solid piece of metal it is not very suitable when dealing with electroplated coatings. It is true that a plated specimen can be pulled and the deposit carefully examined to see when cracks develop but it is by no means easy to do this. A very much simpler method is to take a plated strip of metal and bend this round a former. The former is arranged in the form of a helix, the radius gradually decreasing. The test-piece is clamped on the one end of this and bent round and then carefully examined for surface cracking. The point at which cracks are seen to go right across the specimen can be observed. In the case of a ductile deposit no cracks may form or, alternatively, they will be on the very end of the specimen whereas if the deposit is brittle cracks may be seen quite near to the starting end of the curve. Although formulas have been put forward for calculating the ductility in terms of percentage elongation this test is probably better used as an empirical test, that is to say comparing one deposit with another, the results being expressed by the distance up the former at which the cracks are first observed.

Effect of Working on Structure and Properties

As mentioned above when a metal is deformed its crystal structure will be altered. If a crucible of molten metal is cooled, the crystals will form in a more or less random manner depending to some extent on the speed of cooling. If the mass so produced is put through a roll these crystals will be broken up and will tend to form a long-shaped crystals in the direction of rolling so that it is quite easy by examining a specimen to determine whether it has been rolled or not. If copper is taken as an example it is found that the original sample of copper having the larger crystals will be fairly soft and can be easily rolled or hammered out. However, when it has been rolled out to a small fraction of its original thickness it will be much harder and it will be extremely difficult to roll it any thinner. This is because the crystals have been broken up and, as mentioned before, an aggregate of small crystals is much more difficult to deform than an aggregate of larger ones. Deformation normally takes place within the crystal, the crystal boundaries being on the whole more difficult to deform.

It has been suggested that there is a certain number of unorientated atoms between the crystals forming a kind of cement or filling and this material is very much harder than the crystal itself because since these atoms are not arranged in any particular planes it is not possible for them to slide over one another in the way described above. If, therefore, a piece of copper is cold worked by rolling, hammering or other methods, a hard material is produced and the more it is deformed the more difficult it becomes to deform it further. Thus working the metal alters its physical properties ; it will be harder, less ductile and usually somewhat stronger, and thus a greater force will be required to tear it apart.

Annealing

This process consists in heating the metal to a temperature usually a little below its melting point and then allowing it to cool slowly. When the metal is heated the vibration in the atoms increases and since they are vibrating more rapidly they are much more likely to move out of their allotted position. If two crystals of metal are in juxtaposition then when heated the atoms will start to move about somewhat and there will be a tendency for one crystal to grow at the expense of the other until ultimately perhaps all the atoms will form themselves into a single crystal. By heating the metal in this way therefore it normally softens, so increasing its ductility and reducing its ultimate tensile.

These remarks apply to a pure metal ; in the case of alloys, the position is a little different. Here there may be a condition in which one component of the alloy is dissolved in another. With steel, for example, the carbon may be in solid solution or it may separate out as iron carbide ; when a piece of steel is heated the carbon goes into the solution ; when cooled slowly it separates out again forming layers of iron carbide in the steel.

If, however, when it is dissolved the steel is quenched *i.e.* it is cooled suddenly, the iron carbide does not have time to separate out and remains in solution thus producing a different structure. In this case, therefore, in order to anneal the steel it must be cooled very slowly allowing the carbide to separate out producing a softer material. If quenched, the carbide remains in solution and forms a much harder material. In the case of a pure metal quenching does not make any great difference but with an alloy then the method of cooling is more important.

Hot Work

Metals are normally softer and more ductile when hot and it is usually fairly easy to roll them or otherwise shape them when they are heated to a red heat. Since the metal is already hot it does not require annealing after the treatment so that it can be rolled down several times until the temperature is too low to continue and it has to be reheated again in a furnace.

From the point of view of the metal finisher, however, it should be remembered that the average metal when heated near its melting point oxidizes somewhat on the surface and when it is being hot worked this oxide skin is often pushed into the mass of metal and remains either on or just below the surface. This often produces very considerable trouble in the finishing process. This skin of oxide should be removed by some suitable method before the final processes are applied to the metal.

Fatigue

Metals are said to suffer from fatigue, that is to say when an alternating stress is applied to them they will generally fail after a period of time at a much lower stress than that which would have to be used on a direct pull.

If a round test-piece is held at one end in a chuck and rotated at a high speed and at the same time is loaded on the other end so that it is slightly deformed, an alternating stress is produced in the centre of the test-piece since with every revolution the stress on the centre portion will be first in one direction and then in the other. If the machine is run for some little time it will be found that the test-piece will often break although the stress applied to it is very much lower than one which would produce any effect if applied steadily. This trouble is a very real one in the case of high-speed machinery and parts subject to vibration.

Fatigue failure is a very complicated thing and is somewhat unpredictable in nature. Usually, howhowever, the failure starts at the surface of the metal and the crack proceeds between the crystals not through them. Any small crack on the surface will accelerate this so that a specimen with a rough, etched or highly stressed surface will normally fail much quicker than one which has a highly polishedsurface.

Fatigue failure must be kept in mind when metal parts likely to be subject to this type of stress have to be electroplated. It has usually been found that plating will increase the liability to this type of failure and partiuclarly so if the parts are heavily pickled in acid. This is very important particularly when dealing with parts of aircraft which may be highly stressed.

Hydrogen Embrittlement

In both pickling and plating processes a certain amount of hydrogen is likely to be evolved at the metal surface. The hydrogen atom is considerably smaller than the metal atoms and it is possible for it to penetrate between them. This often happens and hydrogen can diffuse through many metals, it being possible to measure this effect experimentally. When the hydrogen diffuses into the metal it naturally somewhat alters the lattice structure of the atoms and this tends to produce brittleness. It may also collect in certain gaps in the structure or possibly between crystals and build up quite a considerable pressure.

A good deal has been written on this subject and a number of experiments made. Not everyone is agreed on the exact mechanism of hydrogen embrittlement or in fact as to how much of the embrittlement observed in metals which have been pickled and plated is directly due to hydrogen. However, there is no doubt that the effect is produced and that after plating many articles, particularly those made of high-tensile steels, become brittle and are easily fractured.

The effect may be reduced by giving the article a low-temperature heat treatment usually about 200°C for about 2 hours but the correct treatment will depend of course on the metal concerned.

This treatment will generally remove most, if not all of the effect produced, but in some cases permanent embrittlement is produced probably because an actual crack has been formed in the metal surface.

Where the material is thought to be subject to this effect all possible precautions should be taken. It is usual to avoid making the article the cathode in cleaning or pickling processes and immediately after the plating process a suitable heat treatment should be given. In some cases it may be advisable to avoid plating the article altogether and to use some other method of protecting it. However, this effect is only of importance in special cases. Steels below 45 tons U.T.S. are not affected neither are the majority of non-ferrous metals.

Alloys

An alloy is a mixture of two or more metals. Steel is usually referred to as an alloy although carbon is a non-metal.

Most metals contain small quantities of others present as an impurity and just where a metal ceases to be regarded as a pure metal and is considered to be an alloy, is rather difficult to say but generally speaking an alloy is intentionally formed by the addition of a significant quantity of a second metal to the original.

Alloys are extremely important in industry, some of the commonest being brass, bronze, nickel silver, solder and the light alloys of aluminium and magnesium. :

(*Continued in page* 417)

CRISIS IN METAL-FINISHING EDUCATION

IN view of the widespread recognition which is being accorded to the need for increasing the supply of trained technologists it seems hardly credible that an industry so demanding of technical know-how as metal finishing should be slow in taking advantage of facilities made available at its own specific insistence.

That this is indeed the sorry state of things is revealed in a recent statement circulated by Dr. J. E. Garside, principal of Borough Polytechnic, speaking in his capacity as chairman of the Education Committee of the Institute of Metal Finishing.

Dr. Garside points out that for years the metal-finishing industries clamoured for the provision of educational facilities, with associated arrangements for examinations. After much detailed consideration and extensive inquiry by the City and Guilds of London Institute Metal Finishing Advisory Committee, two courses were launched, one entitled " The Metal Finishing Practice Certificate " (Subject 17a), the other " Metal Finishing Technology " (Subject 17b). The first of these examination schemes has been integrated with the National Apprenticeship Scheme for the Metal Finishing and Allied Trades, and yet in spite of all the publicity efforts which have been made, the numbers of candidates taking the Metal Finishing Practice Certificate has dwindled year by year from 40 in 1957 to 25 in 1959.

During 1959, candidates were submitted from only three Colleges, two in the London area and one in the Midlands. The examination in Metal Finishing Technology is a more recent introduction and in 1959 there was only one candidate, although there is no other scheme of examinations which covers the same field. (It should also be emphasized that the City and Guilds of London Institute do not insist that a candidate should attend a College for instruction, if, for reasons of geography, his private address prevents this. Arrangements have always existed whereby students may enter as private external candidates, and in certain subjects such candidates have done themselves considerable justice).

As Dr. Garside further observes, the examining authorities can only take the lack of candidates as an implication that the courses which have been provided are not in fact required by industry, and so a situation has now arisen in which, because of the meagre support, the City and Guilds of London Institute may find it necessary to discontinue offering examinations in the two subjects. Should this happen, there can be few so purblind to deny that it would be a national calamity as far as the metal-finishing industry is concerned.

If the industry is even to survive, let alone go forward with development projects, it is vitally necessary that it should have available a regular supply of practically trained and theoretically qualified young men.

The present situation is a highly critical one for the metal finishing industry and immediate action is called for. In his concluding paragraph, Dr. Garside states that as a personal contribution towards resolving the situation he would be happy to discuss any specific problems which may arise in this connexion with personnel management or other executives in the industry.

It is to be hoped that the warning which Dr. Garside has sounded will not go unregarded.

Metal Finishing Technology

(*Continued from page* 416)

When dealing with an alloy normally two or more types of crystal are present. In some cases all the second constituents may be present in solid solution in which case the structure is homogeneous, but it is more usual to find that more than one phase is present. Thus brass may have an α and a β phase. Down to 64 per cent. of copper the metal usually consists only of the α phase which is the solid solution of the zinc in the copper but with a lower percentage of copper than this the second phase, the β phase, appears which is a chemical compound containing copper and zinc. As the amount of copper decreases the β phase separates and the structure is composed of two different types of crystals. The amount of the second phase which separates will be governed to some extent by the conditions of cooling of the metal.

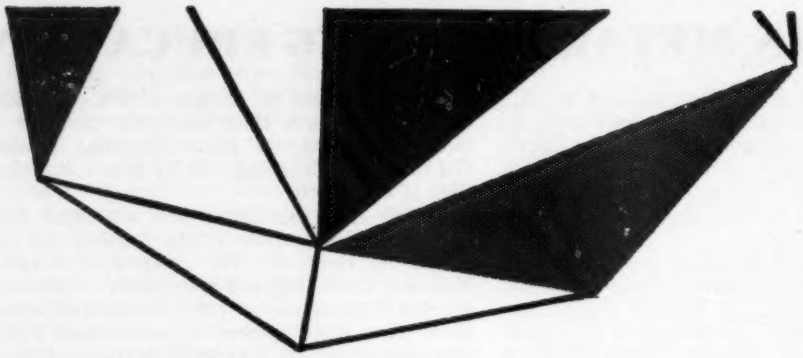
It will be seen that heat treatment and working of alloys may produce somewhat different results from that of a pure metal. Thus brass cannot be annealed in the same way as copper.

Some brasses suffer from what is known as " red shortness " — that is to say that at certain temperatures above red heat they become quite brittle. The same result is obtained with plumber's solder which just below melting point is also brittle so that if a part is being soldered with this material it is necessary to keep it quite rigid until the solder is cooled.

BELGIAN ELECTROPLATERS' MEETING

The Association Belge D'Electrodeposition announces that under the auspices of CEBELCOR a meeting is to be held on December 17 at 3 p.m. at the premises of Fabrimetal, 21, Rue des Drapiers, Brussels.

Anyone interested in attending this meeting should communicate with the Secretariat of CEBELCOR, 24, Rue des Chevaliers, Brussels.



ALBRIGHT & WILSON

NICKEL SULPHAMATE

in nickel plating has special advantages

An electrolyte based on nickel sulphamate makes it possible to plate at very high current densities so that thick deposits can be produced in a short time. In addition the deposit has a very low internal stress and is particularly suitable for electro-forming applications where any distortion must be avoided. The deposits are also extremely ductile.

An example of this is in the production of distortion-free gramophone record stampers that can be rapidly electro-formed in the nickel sulphamate electrolyte. The ductility of the deposits from the nickel sulphamate solution increases the useful life of the stampers.

Another increasing use for nickel sulphamate is in the printing industry where it is used for facing stereos and electrotypes. The plating time is considerably reduced and the deposit is more homogeneous.

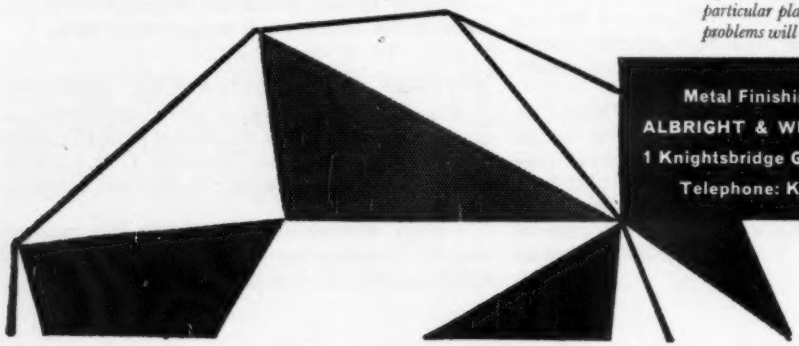
Nickel sulphamate electrolytes can be used for building up worn parts and also for decorative finishes, as the deposits are exceptionally easy to polish.

A detailed investigation of the properties of electrolytes based on nickel sulphamate has been carried out in Albright & Wilson's pilot plant in their Technical Service Department at Oldbury.

Albright & Wilson (Mfg) Ltd also supply Phosbrite chemical polishing solutions for copper and aluminium and their alloys, Plusbrite addition agents for bright nickel plating, together with chemicals for special processes in tin and copper plating and electrolytic polishing of ferrous metals.

Information and advice on your particular plating and polishing problems will be gladly given. Write to

Metal Finishing Department
ALBRIGHT & WILSON (MFG) LTD
1 Knightsbridge Green, London SW1
Telephone: KENsington 3422



FINISHING NEWS REVIEW

U.S. ceramic industry organizes its own career openings

OVER 150 guidance counsellors for qualified young people embarking upon professional careers in the Pittsburgh and surrounding areas were guests at an annual joint meeting of the Pennsylvania Ceramic Association and Pittsburgh section of The American Ceramic Society held at Mellon Institute last month.

The scope of the ceramic industry, its career opportunities, and qualifications required were discussed in detail at afternoon and evening sessions. Interspersed was a tour of the ceramic fellowships maintained at the Institute by member companies. Purpose of the meeting was to present the guidance counsellors with a picture of the nature of the industry and the promising opportunities available.

Open Days at BISRA

Corrosion bureau shows some typical problems

THE British Iron and Steel Research Association held two open days at their Battersea laboratories last month to demonstrate the progress made by the plant engineering and energy division of the Association.

The chemistry department of the Association is also housed at the Battersea address, and on show here was some of the work undertaken by the physical chemistry, corrosion and refractories sections.

In a demonstration of corrosion in air, it was shown that in Great Britain, where the relative humidity is sufficient to cause this type of rusting, the amount experienced in any particular area will depend to a large extent on the sulphur pollution. Well-chosen rust preventative measures can prevent or considerably reduce the corrosion of steel.

Priming paints research

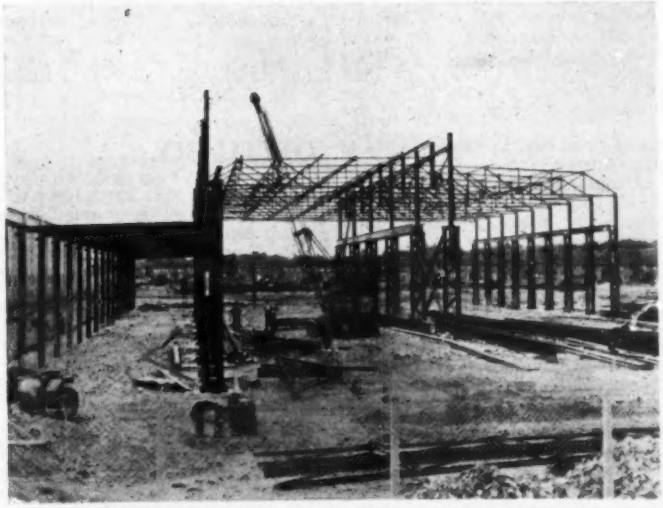
The corrosion committee of B.I.S.R.A. and the British paint industry have co-operated to develop new and better priming paints for structural steel. After 12 years' exposure at Derby or at Brixham, the test panels have been withdrawn.

Corrosion advice bureau

The Association formed the corrosion advice bureau in 1954 to assist industry in applying the technical advances arising from the work undertaken. The bureau's terms of reference go beyond this, however, and it is prepared to advise and guide industry in most problems relating to the corrosion and protection of ferrous metals, whether directly covered by the Associations' researches or not.

Typical problems recently referred to the bureau include the corrosion of steel reinforcements in concrete, the painting of steel plant and structures exposed to the atmosphere, damage to steam pipes, and pitting of ships' hulls.

Sheerwater factory expands



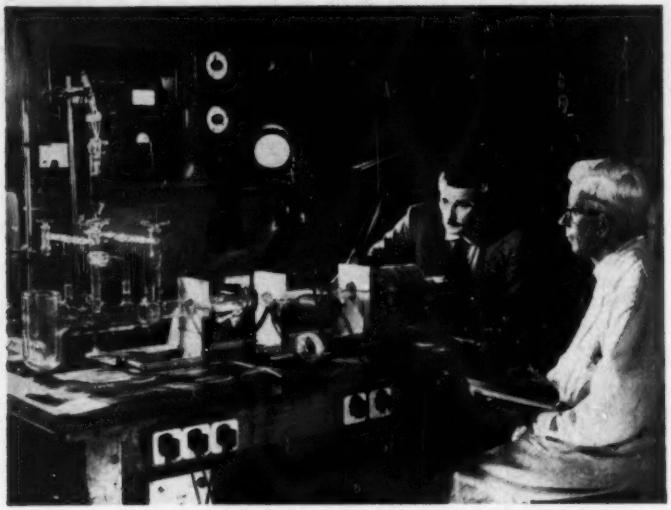
ANOTHER factory in the L.C.C. industrial development area at Sheerwater, near Woking in Surrey, is being built by Efco Ltd. The site is a prominent corner position close to the factory of their subsidiary, Electro-Chemical Engineering Co. Ltd. Work is seen in progress on the new factory scheduled for completion early next year.

OCCA EXHIBITION IN LONDON AGAIN NEXT MARCH

TEN of the 84 exhibitors at the next Oil and Colour Chemists Exhibition to be held in London next March will be showing for the first time, according to the London Section of OCCA who are organizing the event.

Due to be held at the Royal Horticultural Society's New Hall from March 15 to 17, the principal guest will be Prof. Sir Alexander Todd, F.R.S., the chairman of the Advisory Council on Scientific Policy and Professor of Organic Chemistry at Cambridge University. He will perform the opening ceremony at the hall at 3 p.m.

Open Day at Hinxton Hall



Wear and lubrication research equipment at the Hall

AN open day was held recently at the Hinxton Hall laboratories of Tube Investments Ltd. to demonstrate the work being done by the company's research department. Although Hinxton Hall is only part of the T.I. research and development division, which numbers in all some 450 staff under the direction of Sir Ben Lockspeiser, it is playing an increasingly important part in work carried out in the solid state physics field, its main interest. Total staff at the Hall is about 150.

Among a number of items of research shown were some dealing with corrosion studies, including stress corrosion, and corrosion and passivity.

The mechanism of stress corrosion, a serious problem with some heat exchangers, is not fully understood, and a study has been made of the way in which the stress corrosion crack penetrates the metal. Mechanical stress and chemical attack can operate in partnership in bringing this about; the crack penetrates in steps, the crystal structure and the state of strain in the alloy playing an important part. Micrographs illustrating the progression of this type of crack were shown to visitors.

In the studies being made of corrosion and passivity, an understanding of the basic electro-chemistry of the corrosion reactions is being sought, particularly for stainless steels. Knowledge of the conditions under which the protective oxide films are stable should help to predict which of these two factors have to be considered in any given case.

Half-million investment by Hoover's

THE value of Hoover Ltd.'s investment in plant and equipment in the extension to be built at the Hoover (Electric Motors) Ltd., factory at Cambuslang, Lanarkshire will be in excess of £500,000.

This news follows the announcement earlier this week of an agreement with the Board of Trade for an extension of 88,000 sq. ft. to the existing 162,890 sq. ft. factory at Cambuslang, leased from Scottish Industrial Estates Ltd.

The extension is expected to be completed in 1960, when Hoover are to add another 300 employees to the present payroll of 1,450 at Cambuslang.

JAP ALUMINIUM AGREEMENT

THE signing of a fifteen year agreement for technological assistance between Kobe Steel Works of Japan and two Canadian companies, Aluminium Laboratories Ltd., Montreal, and the International Aluminium Co. Aluminium Ltd.'s sales company in the Far East—was announced recently.

Tsuneo Ichikawa, senior managing director of Kobe Steel Works, signed for the Japanese company, Aluminium Ltd., being represented by Mr. H. H. Richardson, president of Aluminium Laboratories Ltd., and J. Boetschi, president of International Aluminium Co.

Under the terms of the contract Aluminium Ltd., offers Kobe a comprehensive technical assistance programme for fabrication of aluminium products in Japan by that company. The Kobe works will purchase their aluminium requirements from the Canadian company to the extent that these cannot be obtained in Japan.

Ferodo premises in Newcastle

NEW premises at 3, Condercum Road, Newcastle-on-Tyne, 4., have been opened by Ferodo Ltd., Telephone: Newcastle-on-Tyne, 39131/2. The premises replace the accommodation in Barras Buildings which the company have occupied in the city for the past 24 years. The company's district manager is Mr. E. B. R. Lockwood.

OBITUARY

Longstaff. We record with regret the death of Lt.-Col. Ralph Longstaff, D.S.O., who was a great-grandson of Henry Blundell, co-founder of Blundell, Spence and Co. Ltd., Col. Longstaff was a director of the company from 1919 to 1953, and became chairman in 1939, a position which war work obliged him to relinquish in the following year. He was 80 at the time of his death.

RUSSIAN ORDER FOR BROOKES POLISHERS

The Tube Investments subsidiary company, Brookes (Oldbury) Ltd., has received an order from V/O Stankoimport, Moscow, U.S.S.R., for two double internal tube polishing machines complete with dust extraction equipment and necessary ancillary equipment. The value of the orders is over £30,000.

The machines are for the internal polishing to mirror finish of stainless steel tubes as used in the dairy, brewing and food industries. Two tubes up to 40 ft. in length, are polished simultaneously.

Earlier in the year, the steel tube division of Tube Investments received Russian orders for stainless and alloy steel tubes valued in excess of £2 million.

NEW COMPANIES

"Ltd" is understood also "Private Co." Figures = Capital, Names = Directors, all unless otherwise indicated.

Coating Contractors. September 2. £5,000. To carry on bus. of manufacturers of and dealers in surfacing, surface preparation and coating materials, etc. Francis M. Richardson, Felix W. Merz, Mark Waghorn.

Yorkshire Heating Supplies, 34, Meanwood Road, Leeds. September 3. £5,000. To carry on bus. of agents for the sale of heating apparatus, etc. Wm. T. Pearson, Walter Watson, Thos. N. Balmer.

Process Heating and Engineering, 178a, Westcombe Hill, S.E.23. September 3. £100. P. F. Joblin, Mrs. B. M. Joblin, Ronald A. Bailey and Brenda W. Causey.

V. and R. Alderton, 6, Watts Lane, High Street, Teddington. September 10. £100. To carry on bus. of grinding and re-grinding tools, etc. Victor E. Alderton, Ronald E. Alderton.

Buckley-Rowley, 10, William Clowes Street, Burslem, Stoke-on Trent. September 11. £1,000. To carry on bus. of heating and ventilating engineers and contractors, etc. Arthur Rowley, Harold Buckley.

Gilbert Bingham, 89, Abbey Road, N.W.8. September 14. £100. To take over the bus. of importers, and dealers carried on at Abbey Road, N.W.8. manufacturers, importers of and dealers in gilding leaf, stamping, foils, etc. Gilbert F. Bingham, Wilfred J. P. Norton.

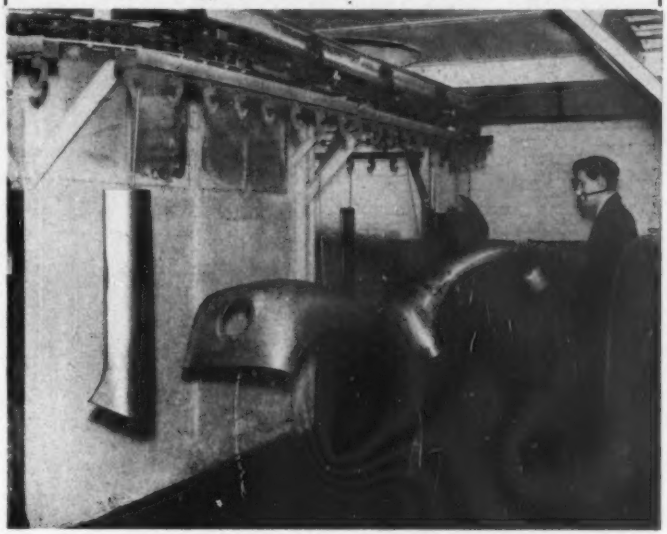
Industrial Stoving, Grainger Road, Industrial Estate, Southend-on-Sea. September 14. £500. To carry on bus. of stove enamellers, etc. Leslie R. Buxton and Dorothy M. Buxton.

Cambrian Plating, 23, Dudley Street. September 18. £1,000. To take over bus. of electro platers carried on at 12, Somerset Place, Swansea by George James and Son Ltd. etc. Hendrik J. Touw, Jacob C. Wolse.

Set Chemicals, 4, Broad Street Place, E.C.2. September 18. £100. To carry on bus. of manufacturers of and dealers in plastics, cinema screens, cellulose, regenerated cellulose, metallic foil etc. Bernard Clayton, Philip Givertz.

From the Register compiled by Jordan & Sons Ltd. 16 Chancery Lane, London, W.C.2.

One-off Metal Protection



SPRAY BONDERIZING AT DODGE BROS.

AT the works of Dodge Bros. (Britain) Ltd. components for the various vehicles made by the firm are seen being treated with "Bonderite," specially prepared for application by an ordinary paint spray gun. The company use this method for pretreating components prior to finishing because their production is so varied that the more normal immersion in either "Bonderizing" or "Spra-Bonderizing" is not practicable.

Using an optimum pressure of 20/30 lb. per sq. in., "Spray Gun Bonderite" is applied to the steel surface of the workpieces in a quantity sufficient to wet the whole surface. The solution is allowed to remain in contact with the surface for a period of 2½ min. to a maximum of 5 min., and the surface is then rinsed by hosing with cold water. Oven drying at 250°F for 5-10 min. follows, although compressed air can be used for this purpose if necessary. Priming is carried out immediately afterwards. An interesting point is that this particular product of the "Bonderizing" range can also be applied by brush when necessary, a decided advantage to some finishers.

Auto-Performances, 43, Commerce Road, Wood Green, N.22. September 24. £500. To carry on bus. of injection mould manufacterers, plastic moulders, model makers, specialists in anodic treatments, motor car engine development and performance specialists, etc. Jack Hornsby, John A. Clark, Montague H. Page.

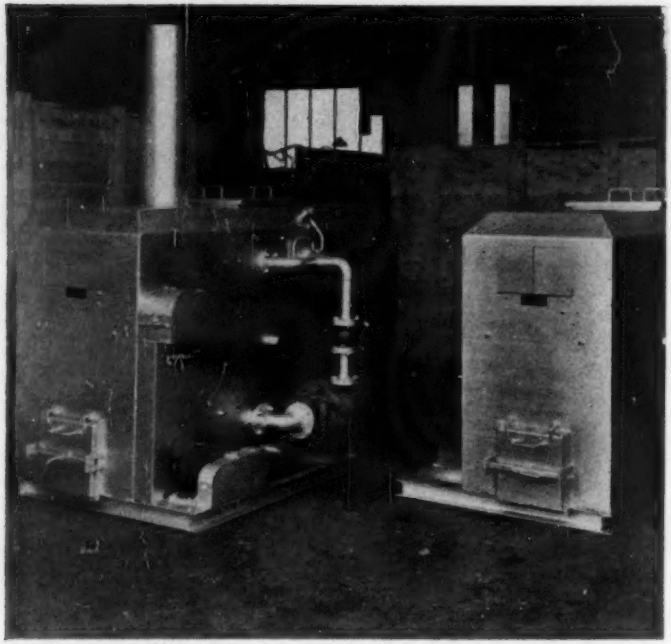
Reeve Polishing and Plating, 85/87, Clifford Street, Lozells, Birmingham. September 24. £10,000. George J. Flynn, George E. Flynn, Wm. H. Badger.

Stelloy, 22, Waterloo Road, Wolverhampton. September 24. £1,000. To carry on bus. of manufacturers of and dealers in steel and alloy roofing and roofing, insulating, non-conduct ing and anti-fouling compositions, etc. Walter H. Hamer and Alan Jeavons.

Perfect Finish Polishing, 33B, Lower Green Lane, Walsall. September 29. £1,000. To carry on bus. of metal polishers and finishers, etc. William F. Dawson, Joseph Andrews.

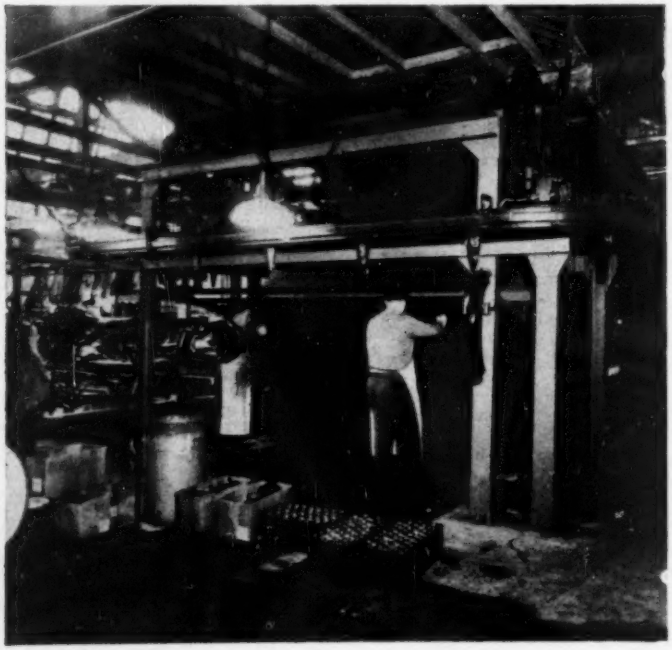
Walsh's (Derby), 85, Prince Charles Avenue, Mackworth, Derby. September 29. £100. To manufacture and deal in paints, enamels, varnishes, etc. Peter Walsh and Mrs. Clarice Walsh.

Tolgus Tin Stamping, Tolgus Stamps, Redruth, Cornwall. September 30. £30,000. To take over bus. of tin streamers and the exploitation of residual deposits from tin mining carried on at Redruth by T. H. Stamps, Ltd., etc. Richard R. Stewart, Cyril U. Stewart.



Above : A washing machine for cylinder blocks has double spray pipes with a wash head pressure of 20 lb. per sq. in., and roller track feed.

Below : A standard design conveyor oven for enamelled motor cycle parts ; a monorail conveyor carries undercoated work back to the dipping station.



A. E. GRIFFITHS LTD.

Smethwick firm celebrating this year looks progress in supplying plant and

In 1934, Cambridge won the Boat Race, Manchester City won the F.A. Cup, and the Maharajah of Rajpipla's Windsor Lad won the Derby ; and at premises in Booth Street, on the Handsworth side of the boundary adjoining Smethwick, Mr. A. E. Griffiths a young engineer of 33, just beginning to find his feet in industry, began a process engineering company that still carries his name.

" A. E. Griffiths (Smethwick) Ltd." the firm was called, although it was not until four years later that the boundary was crossed with an additional factory half-a-mile away in Rolfe Street, Smethwick.

This year, the firm is celebrating its Silver Jubilee. In the intervening years the pay roll has grown from the original dozen names to more than 250, working in four factories. And the company now has a turnover of hundreds of thousands of pounds a year.

Finishing plant specialists

Our readers will be well acquainted with some of the products made by A. E. Griffiths from their advertisements in METAL FINISHING JOURNAL, especially their dust extraction equipment ; polishing benches ; mop dressing cabinets ; spray booths ; ovens of the box and conveyor types for enamelling, cellulose finishing and every industrial drying operation by convection and infra-red process ; and complete processing plants for the finishing industries.

But with the development of the jet engine in the post-war years, the company's know-how in sheet and plate metal fabrication has stood them in good stead. In fact, a large proportion of the company's production is absorbed by the aircraft industry. An unusual product is a long-term engine storage container that is given an " almost-to-destruction " test for air- and water-tightness, and for resistance to impact shocks.

SILVER JUBILEE

back on twenty-five years of uninterrupted equipment to the finishing trade.

The Booth Street works handle the orders for the company's ovens that extend from the simple box-type for batch production to elaborate conveyor ovens for flow output. Some of the latter are so large that they are made for assembly on site, although all export orders are given an operational tryout before despatch.

" One-off " jobs

Complete pretreatment and finishing lines, including the work transport conveyor, are a speciality of the company, and some of the staff in the company's design office are well versed in overcoming the technical headaches that these individual installations often entail.

In fact, so individual is most of the firm's production that a director was quoted as saying recently that they " never seem to make the same thing twice."

But adaptability and a readiness to meet customers' special requirements were watchwords of the founder, and although A. E. Griffiths died at the comparatively early age of 56 three years ago, the company has maintained this attitude to the challenge of development.

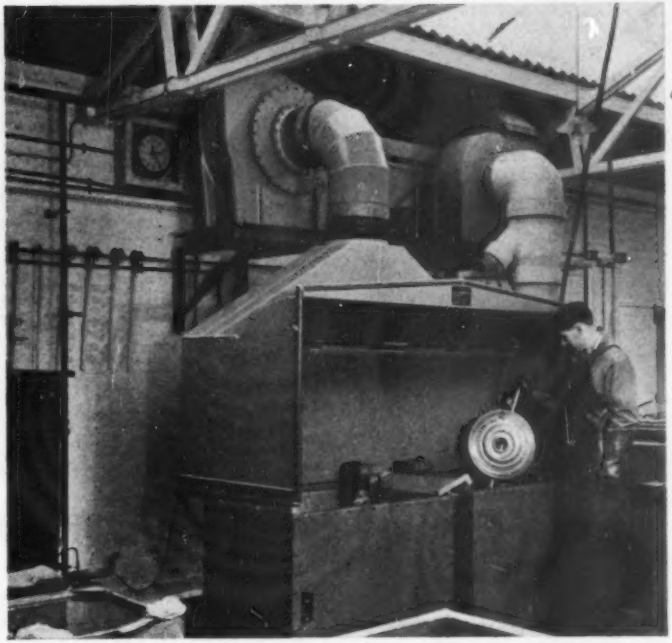
PVC and glass fibre

At the company's Crown Works, a PVC plastics department, set up seven years ago, fabricates fume ducting, hoods, fans and scrubbers, and a good deal of this production makes use of the bright integral colouring possible with this material.

Quite recently a much larger working area has been allocated to the glass fibre department because of the ever-increasing demands among the chemical industries for fabrications in this material. This section has now been running for over four years in the Rabone Lane Works.

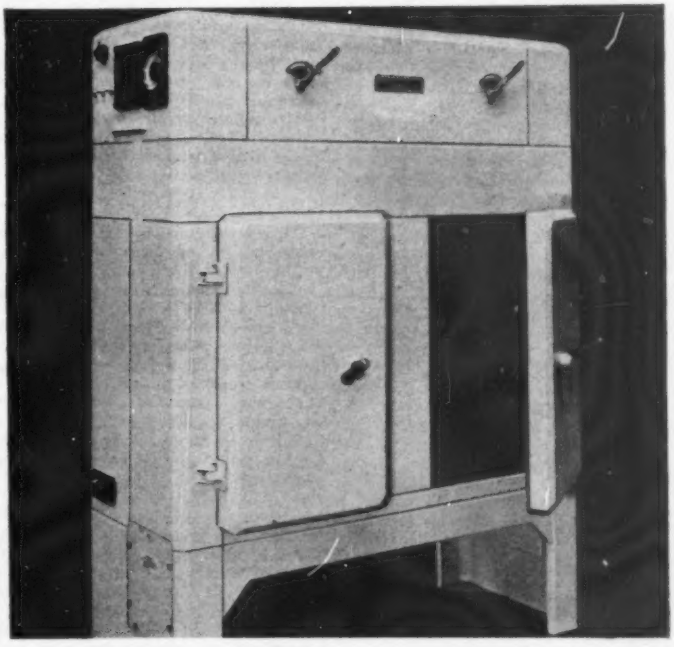
The company has prospered and expanded in its twenty-five years of existence, and recent orders for a £30,000 automatic phosphating and stoving plant, and another £35,000 order for similar equipment, augur well for the future.

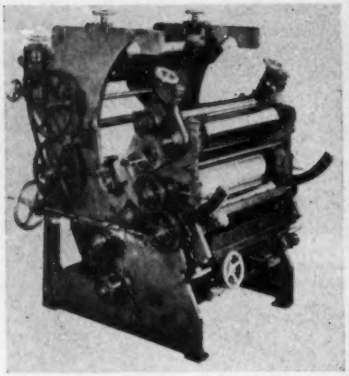
May it continue to expand and prosper, for it is with firms like A. E. Griffiths of Smethwick that Britain's future lies.

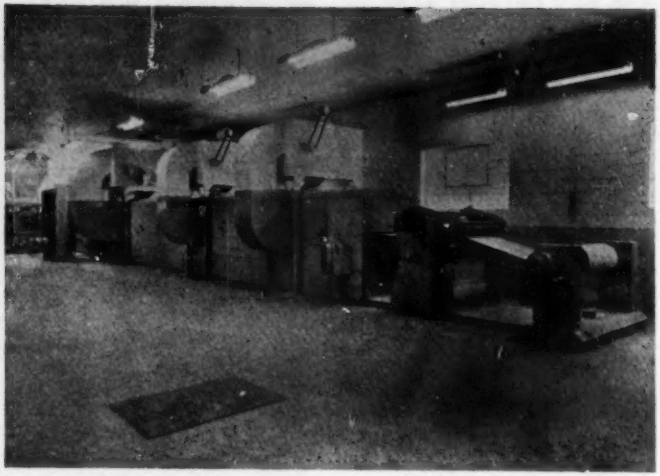


Above : One of several constructions designed and installed by Griffiths for the chemical polishing of aluminium by the "Phosbrite" process.

Below : The company's latest type of box oven providing a modern appearance also has an improved thermal efficiency.







Above—A four-element combination coater, with elements for rotogravure, reverse roll, knife and solution coating. Right—A fabric coating range including tensioner, reverse roll coater, triple zone oven, pull and tension rolls and single unit type wind-up.

Blundell, Spence reorganizes paint making subsidiaries

THE unification of the parent company, Blundell, Spence and Co. Ltd., and its two wholly owned U.K. subsidiaries, Vulcan Products Ltd., and John J. Bowater Ltd., was announced recently. The two subsidiaries have now ceased to trade and their business, the manufacture and distribution of transport and industrial finishes, is being carried on as Blundell, Spence and Co. Ltd.'s industrial paints division.

Decorative finishes will continue to be manufactured at the Hull factory, and production of industrial finishes will be carried on at Slough.

The main branded products of the industrial division will be One-Coat Glossex, Vulfio and Vulfast, all vehicle finishes, in addition to industrial finishes produced to bulk users' specifications.

John J. Bowater Ltd., of West Bromwich was founded in 1956 for the manufacture of machinery oils, greases and soluble oils, and began production of industrial paints and varnishes about 50 years ago. It was taken over by Blundell's in 1949.

Vulcan Products Ltd., began in 1927 in a small private garage in Brixton and was acquired by the Blundell Group in 1954 as a well established business, with works on the Slough trading estate. Last year, the production of Vulcan products and John J. Bowater was integrated at Slough.

U.S.–U.K. LINK FOR COATINGS PLANT

Mather and Platt sign up with Litzler

MACHINERY for the plastic coating of a very wide range of materials by continuous processes is now being offered by Mather and Platt Ltd. Amongst the machines is the considerable range developed by the C. A. Litzler Co. Inc., of Cleveland, Ohio, who are among the pioneers in this field in the United States and with whom Mather and Platt Ltd. have completed a manufacturing agreement and an arrangement for a complete exchange of ideas.

The range is claimed to be the most comprehensive of this type of machinery available in the U.K. Until now, only individual machines for specific operations have been available to British manufacturers. If complete plants for continuous processes were required they have been improvised by the manufacturer's engineering staff.

Wide range

The range consists of a considerable number of machines suitable for different requirements. They fall under the general headings of coating machines, both of the knife spreader and reverse roll types; impregnating machines; embossing machines; drying and gelling machines; fabric and plastic combining machines, and a complete range of the necessary materials handling equipment. In addition, pilot plants and laboratory equipment for any process can be supplied.

Impregnating machinery

The two main types of plant for which considerable demand is anticipated in this country are for fabric coating and impregnating and for paper coating and impregnating.

Among the coated papers being produced are overlay, underlay and saturated papers, pressure sensitive tapes and adhesive coatings for decorative and other uses, including metallic foils, films, etc.

Plastic coatings

A further interesting group of products is plastic coated strip steel and plywood. Considerable interest is being shown in these products and the designing of suitable installations is well in hand. It is said that extensive development work will be required, but it is expected that information will be available to British manufacturers in the near future.

Large producers

Mather and Platt Ltd. are one of the most important producers in the world of textile finishing machinery, much of it similar in character to plastic coating machinery. With this experience and the information available from the United States company on the most recent advances in plastics technology, they are confident that they are now able to meet any requirements of manufacturers in this relatively new and expanding industry.

In view of the increasing use of plastic coated strip steel, the agreement is of first rate importance in the finishing industry.

MEETINGS OF THE MONTH

November 17
Institute of Metal Finishing (Organic Finishing Group, Birmingham Branch). "Finishing methods for reinforced plastics," by G. Langford-Allen and F. Dunkley, at the Engineering Centre, Stephenson Place, Birmingham 2. 6.30 p.m.

November 17
Institute of Metal Finishing (South West Branch). "Vacuum coatings." by A. Weil, at the Royal Hotel, Cardiff. 6.30 p.m.

November 18
Institute of Metal Finishing (London Branch). "Progress in polishing," one day symposium, at the Festival Hall, London, S.E.1. 9.30 a.m.

November 19
Institute of Vitreous Enamellers (Midland Section). "Wet process enamelling of cast iron," by E. R Evans, at the Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham. 7.30 p.m.

November 24
Institute of Plant Engineers (South Wales Branch). "The engineering applications of electrodeposited metals," by J. W. Oswald (Fescol Ltd.), at the South Wales Engineers Institute, Park Place, Cardiff. 7.30 p.m.

November 25
Institute of Vitreous Enamellers (Southern Section). "Trouble shooting," an evening of spontaneous questions with answers by a panel of experts.

November 25 to 27
Society of Chemical Industry (Corrosion Group joint meeting with the Chemical Engineering Group and the Institute of Petroleum). Symposium, "Corrosion problems of the petroleum industry," in London.

November 27
Instituting of Metal Finishing (Sheffield and North East Branch) "The accelerated weathering of organic finishes," by A. A. B. Harvey, at the Grand Hotel, Sheffield. 7 p.m.

November 30
Institute of Metal Finishing. Annual General Meeting, presidential address by A. A. B. Harvey, at the Charing Cross Hotel, London.

December 1
Institute of Metal Finishing (Midland Branch). "Work study in the metal finishing industry," by K. B. Glassby, at the James Watt Memorial Institute, Great Charles Street, Birmingham 3. 6.30 p.m.

December 3
Institute of Metal Finishing (North West Branch). "Embrittlement in plating," by A. W. Slater, at the Engineers Club, Albert Square, Manchester. 7.30 p.m.

December 7
Society of Chemical Industry (Oil and Fats Group joint meeting with the Hull section of the O.C.C.A. and Hull R.I.C.). "Some new reactions on fatty acids and their influence on paints and varnishes," by Josef Weiss, at the Royal Station Hotel, Hull. 7.15 p.m.

December 9
Institute of Metal Finishing (Organic Finishing Group). "Air drying painting systems," by F. Dunkley and D. H. Grover, at the British Institute of Management, 80, Fetter Lane, London, E.C.4. 6.30 p.m.

December 10
Institute of Metals (Birmingham Local Section). "Hot dip galvanizing," by M. L. Hughes, at the College of Technology, Gosta Green, Birmingham. 6.30 p.m.

December 18
Institute of Metal Finishing (Sheffield and North East Branch) "Time and motion study in metal finishing," by K. B. Glassby, at the Grand Hotel, Sheffield. 7 p.m.

Paint Firm for Sheerness Dockyard

NEGOTIATIONS for setting up paint production at Sheerness Dockyard have been started by Hunter and Co., in agreement with Building Developments Ltd., who recently took over the yard from the Admiralty.

The company specialises in the manufacture of paint suitable for ships and scaffolding. They expect to employ initially about 50 people.

Mr. Keyno Rodwell, managing director of Hunter and Co., said that if the negotiations were successful he hoped to expand considerably in the area.

Improved gunmetals at Mond Show

ALL the standard gunmetals in use today have been evolved by trial and error and none of them is capable of providing the ideal combination of requirements needed for the production of quality castings.

At an exhibition held by the Mond Nickel Company at Marlands Hall, Southampton, recently, one of the featured items on display was an improved gunmetal. Its properties were shown in a series of graphs, and a new publication on the subject is to be made available.

The new alloy, 85/6.5/3/3.5/2 Cu-Sn-Zn-Pb-Ni, is claimed to have stable and much better mechanical properties at both atmospheric and elevated temperatures than 85/5/5/5 gunmetal, and still retains its adaptability to the production of pressure-tight castings.

The gunmetal was but one of the wide range of uses of nickel and nickel-containing materials to be featured at the exhibition.

VITREOUS ENAMEL AT COLOGNE FAIR

THE Cologne Hardware Fair running from March 11—15 next year will include a large stand displaying British vitreous enamel hollow-ware.

This is the first time that British goods of this type have appeared in a Continental exhibition and the arrangements have been made by the Vitreous Enamel Development Council in conjunction with the Board of Trade.

Commenting on this excursion into new markets, Mr. Ken Jones, general manager of the Council, said he felt confident that British quality and design have advanced sufficiently to enable our manufacturers to enter the keenly competitive Continental markets.

There is a considerable import trade of hollow-ware from the Scandinavian countries into Britain, but only a negligible reverse flow to the Continent.

Four major hollow-ware producers, all members of the V.E.D.C.'s hollow-ware division, will be exhibiting on the stand. These are Edward Curran Ltd., ("Veristocrat") Jury Hollow-ware Ltd., ("Jetware"); Ernest Stevens Ltd., ("Judge") and Welsh Tinplate and Metal Stamping Co. Ltd., ("Goat Brand," "Thikbas").

Trade and Technical Publications

A new data book describing their range of Cellobond adhesive and binder resins has been recently published by British Resin Products Ltd.

The data book provides basic technical information in a clear and concise manner and is divided into eight sections, each dealing with a separate group of materials in the Cellobond range. These are as follows : adhesive, laminating, polyester, foundry, grinding wheel, brake lining, and rubber compounding resins, and special phenolic polymers.

Copies of the "Data Book No. 1" can be obtained free from the information department, British Resin Products, Ltd., Piccadilly, London.

The latest edition of Inco-Mond Magazine contains a description of the refining processes used to produce platinum metals from the residues of nickel refining undertaken by the Inco-Mond Group.

Articles of general interest concern piston wear, steering mechanisms, pumping slurries, transport of liquids by sea, cathodic protection of metal structures and nickel-plating on the "Lambretta" motor scooter.

A statement on the commercial position of spheroidal graphite cast iron will be of widespread interest and an illustrated description of modern enamelled costume jewellery is included.

The magazine is available free on request to the Mond Nickel Co. Ltd. (Publicity Department), Thames House, Millbank, S.W.1.

* * *

A 20-page, fully illustrated booklet, Rhodium Electroplating Processes, has been revised and reprinted by the Sel-Rex Corpn., Nutley, New Jersey, U.S.A.

The booklet tells when, where and how to use rhodium electroplate to improve product performance and reliability in electrical, electronic and other industrial applications. A wide range of rhodium's decorative applications are also discussed and evaluated.

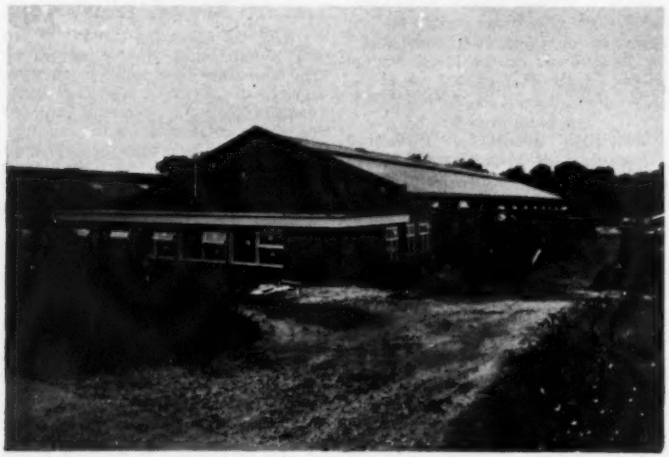
Some of the detailed information contained includes : bath preparation and control of several different rhodium plating formulations ; determination of rhodium in plating solutions ; equipment required ; current densities recommended and general operating instructions. The revised edition also includes a "calculator" chart which permits quick, easy computation of rhodium electroplating costs. British agents for Sel-Rex are M. L. Alkan Ltd., Stonefield Way, Victoria Road, Ruislip, Mddx.

* * *

The metal finishing section of the new demonstration centre being built by Cellon Ltd., Kingston-on-Thames, is briefly described in the latest issue of the company's Bulletin. With the new amenities available, the company says it will be able to develop and demonstrate practically every type of surface coating applied under conditions similar to those operating in customers' factories.

The metal finishing section incorporates the latest type of spray booth, and electrostatic spraying room fully automatic, a full-size Ballard gas-fired and conveyorised oven, and a Metropolitan-Vickers infra-red stoving unit capable of stoving articles up to 4 ft. by 3 ft. Further demonstration centres are either already in operation or will shortly be completed in other of the main centres of the U.K.

Electropol's New Factory



THE new extension to the factory of Electropol Processing at the Farnham Trading Estate, Surrey, will treble its present capacity. This is the fourth extension since 1952 when Electropol moved from the Nissen hut opposite the Bourne Mill of Domesday Book fame at Farnham seven years ago. The new extension of 13,000 sq. ft., designed and constructed by Hewitts of Cranleigh, will considerably increase the facilities for the Electropol processing of stainless steels.

Electropol Processing Ltd. is one of the pioneer British companies in applying the well-known laboratory technique of electro-polishing of metal on a full commercial scale. The company's patent method leaves a permanently bright, polished surface, claimed to be self-repellent of dirt and moisture.

During the past ten years the company has electro-polished many millions of products fabricated in stainless steels. For one motor accessory manufacturer alone it has processed 15 million components.

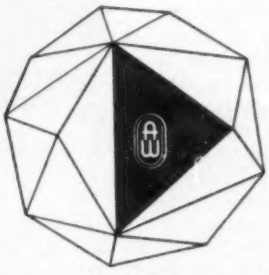
The company is one of those concerns that started in a small way, making sure and steady progress and continually improving its techniques by the experience gained. Considerable production study has increased the speed and efficiency of the process.

The process was developed and patented with additional world patents by Electropol Ltd., of Poynton, Cheshire, and Electropol Processing has the sole jobbing rights for the United Kingdom. The establishment of the processes overseas, either on direct production or a licensing arrangement, is also under way.

The roof and framework of the new building is in the Cranley System of pre-cast, tailor-made, reinforced concrete, developed and designed by Hewitt's of Cranleigh (F. and D. M. Hewitt Ltd.).

Plusbrite S.F. + Standard Plusbrite = Plusbrite Duplex

The best formula for a fully bright nickel plate with maximum corrosion resistance



PLUSBRITE S.F. is a *new* sulphur-free addition agent for use where maximum corrosion resistance is required.

A bath containing PLUSBRITE S.F. has excellent levelling characteristics and produces a uniform *semi-bright* deposit of high ductility and low internal stress. This semi-bright finish can be buffed. Alternatively a further deposit from a standard Plusbrite (PB-N1 and PB-N2) electrolyte will produce a *fully bright* nickel plate particularly suitable for car trim and similar products which require a bright finish and good corrosion resistance.

Plusbrite addition agents are easily controlled and are not removed by filtration, so operating costs are kept to a minimum.

Plusbrite

addition agents provide

THE LOWEST PRICED NICKEL PLATING PROCESSES

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1 Knightsbridge Green, London SW1
Telephone: KENsington 3422

TSW/630

Latest Developments in PLANT, PROCESSES AND EQUIPMENT

Range of Air Compressors

A DEVELOPMENT of their oil-cooled rotary "Power Vane" compressors is announced by the Consolidated Pneumatic Tool Co. Ltd., 232, Dawes Road, London, S.W.6, with the introduction of the Class R range for stationary electric operation, together with optional water cooling of the oil as an alternative to air cooling.

The compressor consists of a simple vane-type rotor enclosed in a sealed compression casing. The rotor is positioned so that it is eccentric with the casing. Sliding vanes inserted radially in longitudinal slots in the rotor, create sealed sectors of varying capacity. Each sector increases or decreases in size as the sliding vanes follow the changing contour of the casing. Inlet ports are positioned so that air is taken into the casing when the gap between rotor and casing wall is increasing. As the sector rotates towards the discharge ports, its volume is decreased by the convergence of casing walls and rotor body, and the retraction of the sliding vanes. This decrease in sector volume continues until full compression is reached. The rotary principle results in smooth operation and pulsation-free air delivery. Inlet and discharge porting eliminates valves, and two stage compression develops top performance without excess loading of parts.

The oil is circulated by the pressure differential between the receiver and compressor and is metered by a gear-type pump. Cooling of the oil is effected either in a fan-cooled radiator or, where it is necessary to avoid undue raising of the surrounding air temperature (and adequate water supplies exist), by a water-cooled unit.

The new range consists of units with capacities of 100, 135, 160, 300 and 510 cu. ft. per min. at a pressure of 100 lb. per sq. in.

Specific features include a gradual unloading control to regulate compressor output, Vokes Micro-Vee type filters with cleaning device, and squirrel cage screen protected motors with star delta starters for wall mounting. Further features include the use of Norgen automatic drain valves and a hand-operated starting valve. To build up when starting and to bleed off this pressure when closing down, an automatic service discharge valve is installed on the discharge end of the oil separator.

The model 365-REW-2 in the Power Vane range is illustrated in Fig. 1.

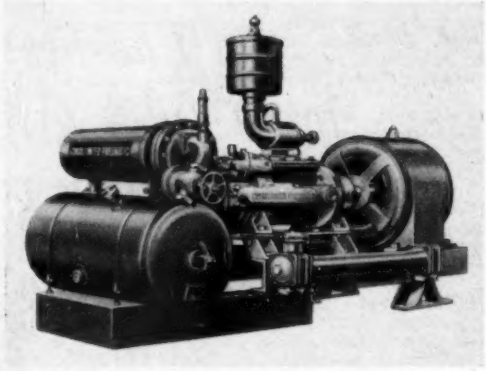


Fig. 1.—A water-cooled "Power Vane" compressor

Spiral Elevator

AN elevator having a speed regulator for handling bulk materials has been developed by Russell Constructions Ltd., 9 Adam Street, London, W.C.2 (Fig. 2).

It operates on the screw conveyor principle and consists of a feed hopper from which two opposed horizontal spirals feed into a slightly inclined elevating spiral reaching to a height of 5 ft. 6 in. This height can be increased up to 11 ft. by an easily fitted extension piece that can be assembled or dismantled in less than five minutes.

The unit is powered by a small electric motor through an infinitely variable torque converter, so that the output can be regulated accurately. When fitted with a 1½-H.P. motor, the range is from 3 to 12 tons per hour and with a ¾-H.P. motor a range of ½ to 3 tons is obtained.

The feed hopper has a capacity of 4½ cu. ft., slightly more than the contents of an average sack, and as its feeding height above ground level is only 18 in., a minimum of physical effort is required to load it.

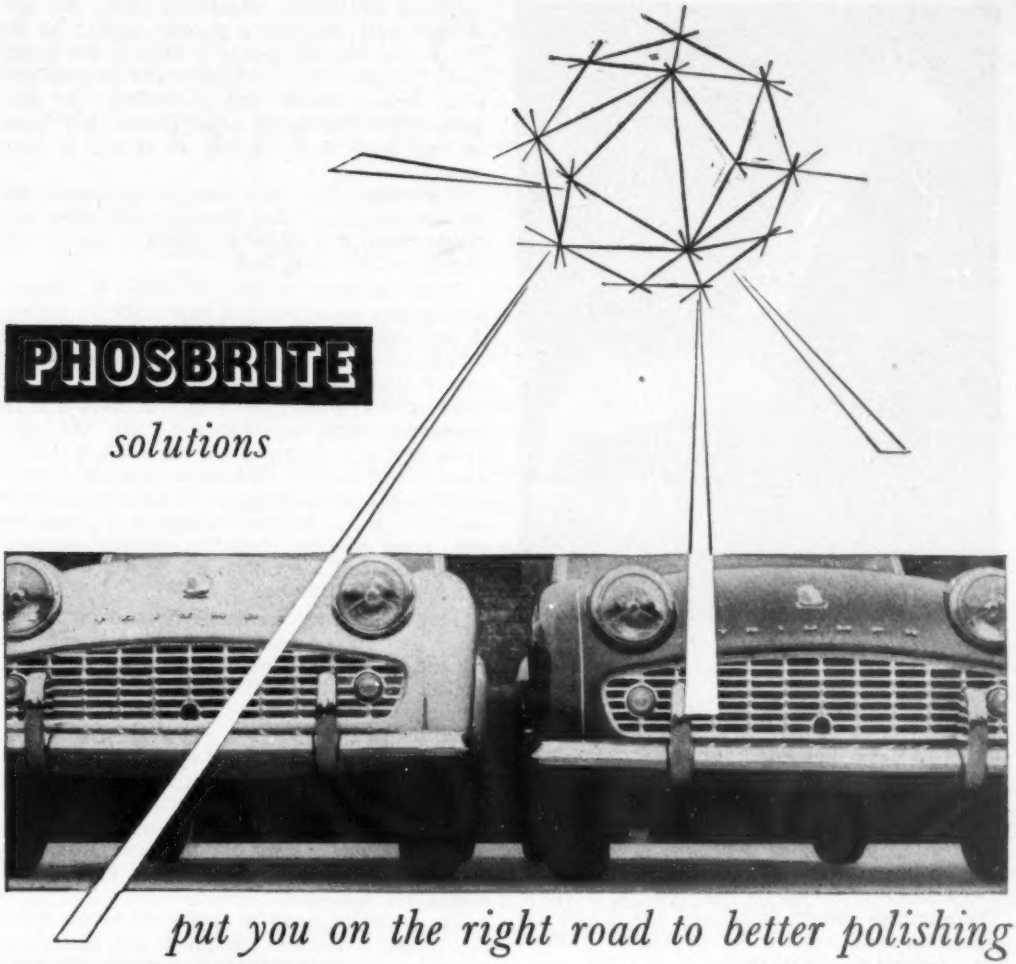
The machine can be very easily dismantled for cleaning, an operation requiring only a few minutes that can be carried out without the use of tools. All the bearings of the spiral units are sealed to prevent any possibility of the handled material being contaminated by lubricant.

The machine is quiet in operation and raises no dust. The horizontal spirals run at a low speed,

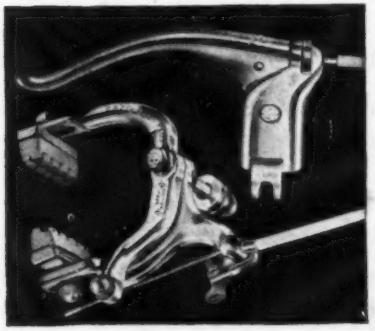
(*continued in page* 430)

PHOSBRITE

solutions



put you on the right road to better polishing



Whether it is car trim (like the Triumph T.R. 3 grille above) or cycle brakes (like the G.B. Cycle Components Ltd. product on the left) you will find that chemical polishing with Phosbrite solutions saves time and money.

There are Phosbrite solutions for chemically polishing aluminium and copper and their alloys and for electrolytic polishing of alloy and stainless steels.

Albright & Wilson (Mfg.) Ltd. also supply Plusbrite addition agents for bright nickel plating, together with chemicals for special processes in tin, copper and nickel plating and electrolytic polishing of ferrous metals.

Write for full information to

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ALBRIGHT & WILSON (MFG) LTD
1 Knightsbridge Green, London SW1
Telephone: KENsington 3422

EBW/681

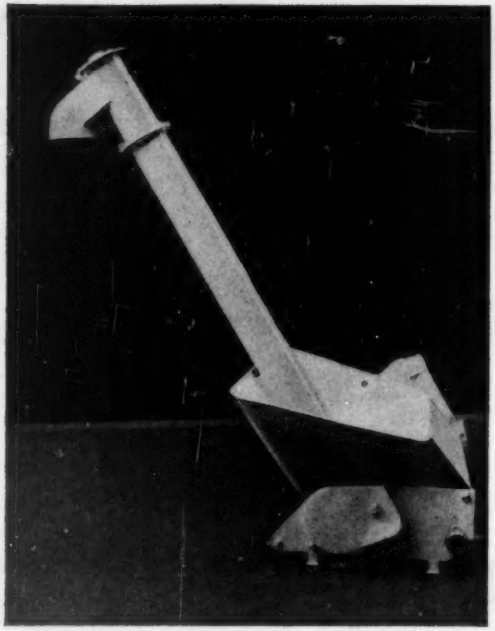

Fig. 2.—A spiral elevator that can also be used as a mixing hopper.

and effective scavenging of the hopper without possibility of cavitation is assured. The elevating spirals rotate at four times the speed of the horizontal spirals.

The elevator can also be used for mixing two different materials during the lifting cycle. By partitioning the hopper into two compartments and feeding different products into the respective compartments, a one to one mix is obtained. The materials can be mixed and elevated in any other proportion required by varying the pitch of the screws of the spiral feeds.

The unit is mounted on trolley wheels and can easily be moved to different points by the operator. It can be used to elevate almost any kind of bulk material and consequently has applications in a great variety of industries.

Metal Conditioner

A METAL conditioner recently introduced by Allweather Paints Ltd., 36, Great Queen Street, London, W.C.2, is claimed to combine in one application the advantages of metal pretreatment with the first coat of a paint system. It is so formulated that it bonds itself into the metal and becomes an integral part of that metal, the makers say.

"Pitan" conditioner is said to be effective on non-ferrous metals such as zinc, brass, copper, cadmium, aluminium, aluminium alloys, and galvanized work, and has a priming application for non-ferrous surfaces applied to steel by the metallising process. It is designed also for steel and other ferrous metals, and particularly for shot-blasted, grit-blasted and flame-cleaned steel where an early coating is required to protect it from corrosion.

The makers also claim that the conditioner has an adhesion figure twice that of an orthodox, first class primer, and forms an adhesive film on the surface of the workpiece.

When air-dried on steel or cadmium, Pitan is said to have an adhesion of over 3,000 lb. per sq. in. and when stove dried it is practically impossible to remove it from any metal substrate; thus it cannot crack, chip or flake.

Supplied as a single solution, it is claimed to be completely stable, and does not "gell" like some 2-can type of etch primers; it can safely be left in open pots or in spray equipment overnight without solidifying, or even skinning. It has a high solvent resistance, and is therefore suitable as a primer for most types of paint, including synthetic finishes, stoving enamels and celluloses. It will withstand petrol without difficulty.

The conditioner can be safely used on metals which have subsequently to be welded, leaves little ash and will cause no obstruction in the weld, and it gives off no obnoxious fumes in the process of welding, the makers say. The dried film is non-toxic.

In use, the surface of the workpiece should be clean and free from grease, as otherwise the etching action may be retarded. Such materials as paraffin and distillate should be avoided for surface cleaning, white spirit may be used but the most satisfactory results will be obtained by using Pitan metal conditioner thinners.

The conditioner can be applied by brush, spray or dipping. If severe conditions are to be encountered, brush application is generally the most satisfactory. Supplied in a consistency ready for brushing, it may need minor thinning to allow of easier application on relatively porous surfaces such as shot-blasted steel or metal-sprayed surfaces. Normal viscosity for brushing is approximately 100 secs. (by Ford Cup).

For spraying, the viscosity may range between 60-80 secs. F.C. requiring the addition of ¾ pint of thinners to a gallon of the etching primer. A suitable dipping viscosity is 20 secs. F.C. requiring the addition of approximately 2 pints of dipping thinners to a gallon of the etching primer. Covering capacity is said to be 60-80 sq. yd. per gal. approximately, according to surface. It dries in about 20-30 min. The makers say it is unsuitable for any non-metallic surface.

(*continued in page* 432)

ELECTRO-PLATERS

A.I.D., A.R.B. & I.A. Approved

ELECTRO-PLATING—Chrome, Copper, Nickel, Cadmium, Silver, Zinc, Bright Nickel, Bronze, Tin, etc.

ANODISING—Chromic and Sulphuric Acid processes. Decorative Silver Anodising and Sealing in longest dimensions a speciality.

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24-HOUR SERVICE *on repetition work.*

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INTRODUCING TO ALL ANODISERS MAGNUS ALTRETE H

THIS NEW ADDITION TO THE MAGNUS RANGE OF METAL FINISHING CLEANERS GIVES YOU

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Plant, Processes etc.

(*Continued from preceding page*)

Swarf and Refuse Tipping Truck

A NEWLY designed tipping truck has been introduced by Powell and Co., Burry Port, Carms., S. Wales, for the collection and disposal of swarf, clinker, waste, etc. The body is made of $\frac{1}{8}$ in. steel plate throughout.

The truck, illustrated in Fig. 3, is easily handled even in confined spaces and is shaped so that it will roll over quickly and easily to dump the contents. It holds approximately 12 cu. ft., and is of convenient overall size, $33\frac{1}{2}$ in. high, 40 in. long, 30 in. wide.

It is manoeuvrable, having two main wheels and a rear swivel castor. The castor has a long stem, reinforced against the heavy treatment usually given to trucks of this sort. The standard model is fitted with 8 in. dia. rubber tyred wheels or cast iron wheels.

Servicing Scheme for Dust Collectors

A SCHEME has been introduced by Dallow Lambert and Co. Ltd., Thurmaston, Leicester, to keep unit dust collectors supplied by them in good condition and functioning efficiently.

A fully trained service engineer makes regular visits at six-monthly intervals, or at other dates mutually agreed, and services each dust collector, replacing any parts that are necessary to put the equipment in first class working condition. The charges for this service are reasonable as an encouragement to all users of the equipment to avail themselves of the benefits that can be derived—giving a longer working life to the units, obvious advantages to the operators and machines, and compliance with Factories Act Requirements regarding regular inspection of such collectors.

Each firm participating in the scheme is provided with a maintenance service register which can be shown to H.M. Inspector of Factories during his periodic visits.

Immersion Process For Metals

THE "Endurion" process introduced by the Metal Finishing Division of Pyrene Ltd., by arrangement with the B.B. Chemical Co. Ltd., provides a non-toxic, dry, inorganic, grey coating which, in conjunction with a "Parkerized" zinc-phosphate surface, confers greater corrosion resistance than that normally produced by "Parkerizing" and oiling.

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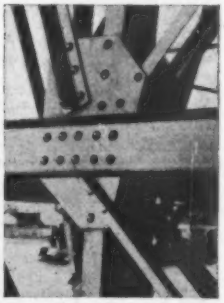

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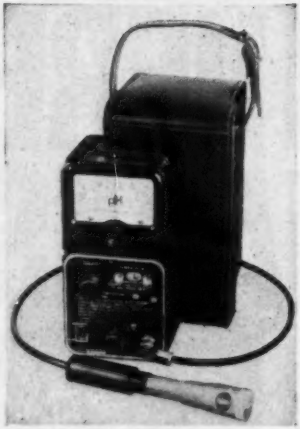

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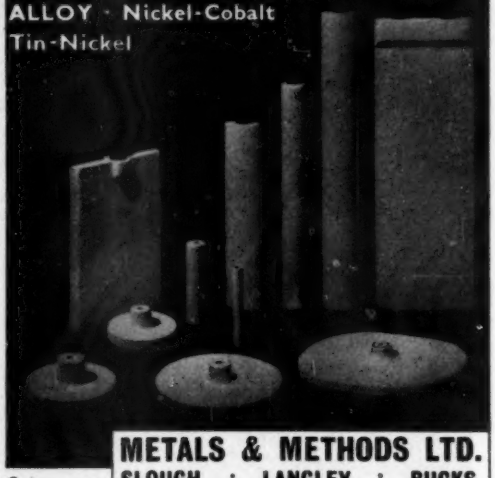

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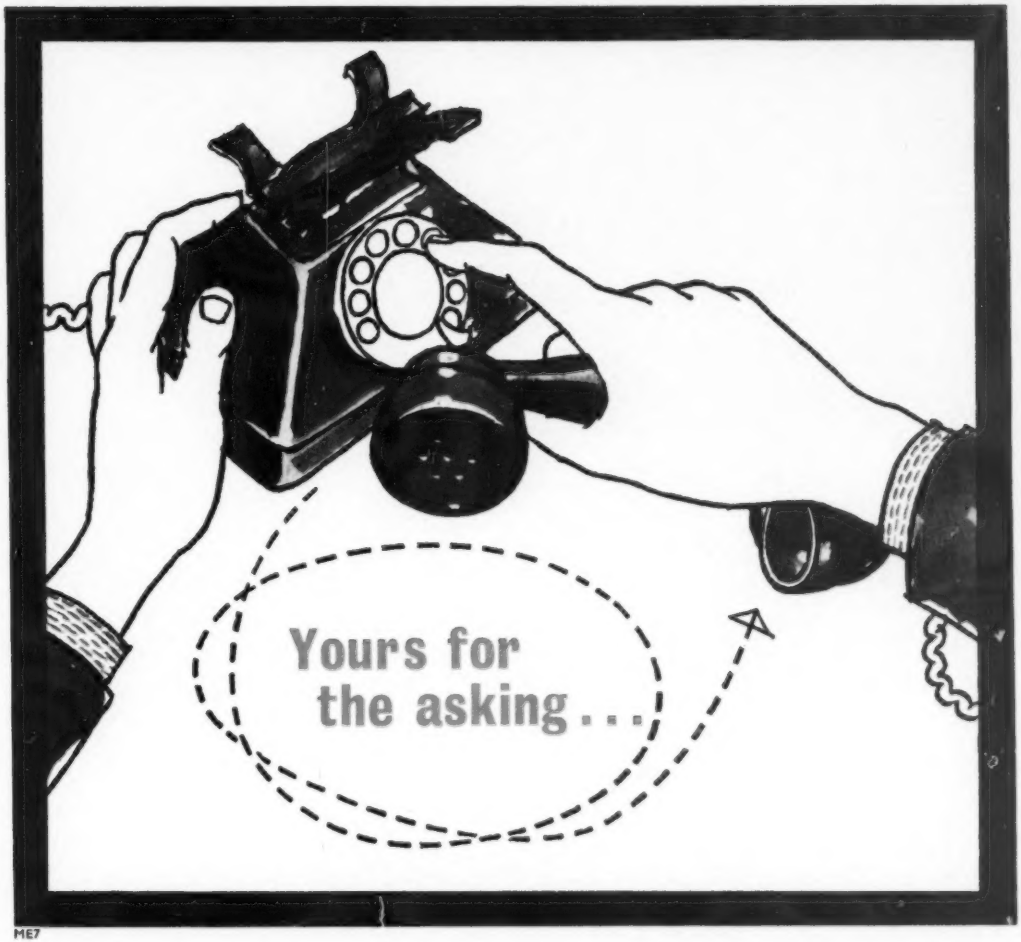

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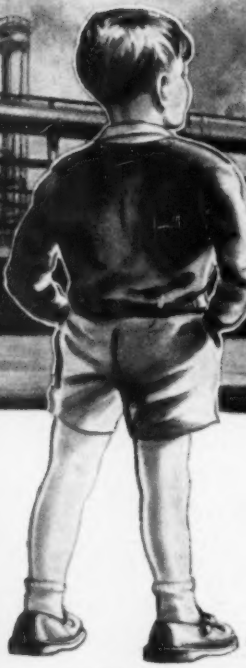

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